STEMMING THE PLUTONIUM TIDE: LIMITING THE ACCUMULATION OF EXCESS WEAPON-USABLE NUCLEAR MATERIALS

ARING

BEFORE THE

SUBCOMMITTEE ON
INTERNATIONAL SECURITY, INTERNATIONAL
ORGANIZATIONS AND HUMAN RIGHTS

OF THE

COMMITTEE ON FOREIGN AFFAIRS
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

SECOND SESSION

MARCH 23, 1994

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STEMMING THE PLUTONIUM TIDE: LIMITING THE ACCUMULATION OF EXCESS WEAPON-USABLE NUCLEAR MATERIALS

WEDNESDAY, MARCH 23, 1994

HOUSE OF REPRESENTATIVES,
COMMITTEE ON FOREIGN AFFAIRS,
SUBCOMMITTEE ON INTERNATIONAL SECURITY,
INTERNATIONAL ORGANIZATIONS AND HUMAN RIGHTS,
Washington, DC.

The subcommittee met, pursuant to call, at 1:24 p.m. in room 2200, Rayburn House Office Building, Hon. Thomas Lantos (chairman of the subcommittee) presiding.

Mr. LANTOS. The Subcommittee on International Security, International Organizations and Human Rights will be in order.

Let me begin by apologizing for starting late. Votes on the floor take precedence over all other activities.

I would like to welcome our distinguished panelists. I am delighted you are able to join us in discussing this matter of the utmost concern to international security: the rapid accumulation of surplus weapon-usable plutonium.

ASSESSING THE PLUTONIUM THREAT

We have been preoccupied lately by North Korea where troubling developments seem to occur daily. It is indeed an alarming and potentially explosive situation. In our haste to address this most serious and glaring nuclear proliferation threat, however, we must be sure not to miss the forest for the trees.

The United States is pressing for international inspections of North Korea's nuclear facilities to determine whether it has diverted sufficient plutonium to make one or two crude nuclear weapons. At the same time, global stocks of plutonium continue to escalate so that if something is not done soon, there will be enough surplus plutonium on hand in a decade to make perhaps more than 80,000 nuclear weapons.

I urge our administration to take the lead in addressing this most serious problem.

Where does all this excess plutonium come from?

Basically, there are two sources. Roughly 200 metric tons of plutonium, enough for maybe 40,000 bombs, are expected to be recovered from dismantled warheads under the START I and START II treaties, as well as under agreements between the United States and the former Soviet Union on tactical weapons.

I am not, of course, suggesting that we renege on these arms control agreements but rather that we give close attention to how best to manage this recovered plutonium both here and in Russia in order to minimize the risks of proliferation. In this context, I welcome the developments of recent days and weeks.

The majority of plutonium, however, will come not from dismantled weapons but from reprocessing spent fuel from civilian nuclear reactors. In an October 1993 letter to a Member of Congress, the President made this comment about reprocessing, and I quote: "The United States does not encourage the civil use of plutonium. Its continued production is not justified on either economic or national security grounds and its accumulation creates serious proliferation and security dangers."

Two recent studies, one commissioned by the Defense Department and the other by then National Security Advisor Scowcroft, reach similar conclusions. I am very pleased that we have with us today two of the principal authors of these studies, Dr. Brian Chow of RAND, and Dr. Catherine Kelleher, Vice Chair of the National Academy of Sciences' Committee on International Security and Arms Control.

At their request, the executive summaries of these two excellent studies will be included in the record of this hearing without objection.

[The information appears in the appendix.]

I should say a word about a particularly disturbing propaganda video released by a Japanese Government-owned nuclear fuel company.

The video depicts plutonium as a cuddly cartoon character named Pluto Boy who assures viewers that plutonium is safe enough to drink and that it is impossible to make a bomb from plutonium used in reactors.

The fact is, of course, that an infinitesimal amount of plutonium causes cancer if absorbed into the body and that reactor-grade plutonium is only slightly less suitable than weapon-grade for making nuclear bombs.

I commend Secretary O'Leary for her condemnation of this outrageous and cynical attempt to hide the dangers of plutonium from the Japanese people.

COUNTERING THE PLUTONIUM THREAT

I am mostly concerned about two issues. First, what can be done to reduce the further accumulation of plutonium in the years ahead? And, secondly, what are the prospects for ensuring that surplus plutonium does not fall into the wrong hands?

I am very pleased that the administration is making progress in limiting the accumulation of surplus plutonium. I once again wish to applaud Secretary O'Leary for recently concluding an agreement which will end Russian production of plutonium for nuclear weapons. I also commend the administration's efforts in negotiating a global cutoff of plutonium production for weapons purposes.

I would like now to say a word about the question of safeguarding and securing excess plutonium.

The United States and Russia recently agreed to permit each other to inspect facilities used for storage of plutonium recovered

from nuclear weapons. This agreement goes a long way toward reassuring each side that plutonium from dismantled warheads is not simply being returned to the other's nuclear arsenal.

The case of Iraq illustrates the fact that international safeguards as applied today are far from being foolproof. It is especially difficult to safeguard bulk plutonium facilities. Accounting uncertainties make it very difficult to determine if plutonium has been diverted for weapons use.

I understand that a government facility in South Carolina still has considerable problems in connection with this issue.

In conclusion, I am concerned with the fact that the growing stockpiles of surplus plutonium may prove to be a welcome resource to nuclear proliferators. I am very pleased by the steps the administration has taken to contain and safeguard this accumulation, especially on the military side. Yet, a great deal more needs to be done.

The witnesses before us today possess a wealth of expertise on the subject and I look forward to their testimony.

Before calling on our distinguished panel, let me ask each member to recognize the fact that our audience is a nontechnical audience. I would ask you, therefore, very seriously to state your positions and explain your points of view in a singularly nontechnical fashion.

Your prepared statements, of course, will be entered in the record in their entirety but I would like to hope that an intelligent and interested American citizen with no preparation or background or understanding of this field would be able to go away after listening to you as having been greatly enlightened on an issue of enormous importance.

I would also like before we begin the testimony to thank Ted Hirsch of the subcommittee staff and Mike Ennis on the minority staff for doing an outstanding job in preparation of this hearing.

We will begin with you, Mr. Einhorn.

STATEMENT OF ROBERT J. EINHORN, DEPUTY ASSISTANT SECRETARY FOR NONPROLIFERATION, BUREAU OF POLITICO-MILITARY AFFAIRS, DEPARTMENT OF STATE

Mr. EINHORN. Mr. Chairman, thank you very much for the opportunity to testify on the challenge posed by the accumulation worldwide of weapons-usable, fissile materials, the challenge you alluded to in your opening remarks.

The Clinton administration's nonproliferation policy includes a comprehensive program to address this important challenge. A key element of that program is the President's proposed multilateral ban on the production of fissile materials for nuclear weapons purposes, the so-called cutoff convention.

A cutoff would put a verifiable cap on plutonium and highly enriched uranium available for nuclear weapons programs worldwide, both in the five avowed nuclear weapon states, as well as in the so-called threshold states that have not yet joined the Nonproliferation Treaty.

A second element of our program is to submit all U.S. fissile material no longer needed for our defense programs to International Atomic Energy Agency safeguards inspections. In this regard, the

President has agreed with President Yeltsin that United States and Russia would consider jointly how materials released from disarmament could be placed under safeguards so as to promote transparency and to ensure that those materials would not be reused in nuclear weapons.

A third element of our policy, Mr. Chairman, is to discourage all fissile materials in regions of proliferation concern. In particular, a key goal for our handling of the North Korean nuclear issue is to ensure the full implementation of the North-South Joint Declaration on Denuclearization, which prohibits all reprocessing and enrichment facilities on the Korean Peninsula.

A fourth element of our approach deals with plutonium production and use in civil energy programs. This is a question you mentioned just a few moments ago. The United States is seeking to develop a consensus on the need to limit and eventually reduce the stockpiling of plutonium for civil nuclear programs and to ensure that existing material is subject to the highest standards of safety, security and international accountability.

In this connection, we have stressed the importance of balancing supply and demand of separated plutonium in order to avoid the buildup of stocks that have no legitimate near-term use.

One word, Mr. Chairman, about the U.S. attitude toward the civil use of plutonium and you quoted the President in his correspondence.

Mr. LANTOS. I take it you agree with him.

Mr. EINHORN. I absolutely agree with him.

As you mentioned, we do not encourage the civil use of plutonium. We do not believe it is justified on economic or nonproliferation grounds and our actions bear this out.

We do not reprocess or use plutonium for either nuclear power or nuclear explosive purposes. But at the same time, we do not use the leverage available to us through our consent rights over the disposition of U.S. origin fuel to interfere with the civil programs of nuclear cooperation partners in Western Europe and Japan that have strong nonproliferation records.

We believe that using our consent rights in such a coercive fashion could lead to a confrontation with close friends and allies whose cooperation is essential to our broader nonproliferation goals such as pursuing a comprehensive test ban, a cutoff convention and stronger export controls.

We need their cooperation, sir, and if we confront them on this issue, we are less likely to get it.

A fifth element of our fissile materials policy involves——

Mr. LANTOS. But if I understand what you are saying, we would like to confront them on this issue but for reasons of what the French call force majeure we choose not to. Is that correct?

Mr. EINHORN. Well, we have our own views on the utility, the economics, the nonproliferation consequences of civil uses of plutonium.

The French, the British, the Japanese, our other friends, they understand those views. And, as I said, we put our money where our mouth is. We do not engage in these activities ourselves.

But we think to use the leverage over them via our consent rights would lead to a confrontation and it would make these good

friends of ours less willing to work with us on projects of vital importance to our nonproliferation interests.

Mr. LANTOS. Yes.

Mr. EINHORN. Our fifth element of our program involves the long-term disposition of plutonium. We have initiated a comprehensive study of options for long-term disposal that takes into account technical, nonproliferation, environmental, budgetary and economic considerations.

The sixth and final element I will mention deals with highly enriched uranium which is not directly on the agenda of this meeting. We have agreed to buy from Russia 500 tons of HEU, highly enriched uranium, from dismantled nuclear weapons. That will be blended down to low enriched uranium for use in peaceful nuclear programs.

We have also sought to reduce the civil use of HEU by continuing our longstanding and highly successful policy of converting research and test reactors throughout the world to operate on low enriched uranium rather than high enriched uranium.

Several of these elements in the administration's program come together in our nuclear relations with Russia and other states of the former Soviet Union. The U.S.-Russia bilateral nuclear agenda was outlined in a joint statement on nonproliferation issued by Presidents Clinton and Yeltsin at their summit meeting in January in Moscow.

It covered such important priorities as placing excess defense materials under safeguards, working together on a fissile cutoff, strengthening material accountancy systems, as well as shutting down Russian plutonium production reactors.

In sum, Mr. Chairman, we have put in place the key elements of a comprehensive strategy for dealing with the serious but varied challenges posed by growing stocks of fissile materials worldwide. Those elements are spelled out in detail in my prepared statement and can be elaborated on this afternoon by me or my colleagues.

Thank you very much.

[The prepared statement of Mr. Einhorn appears in the appendix.]

Mr. LANTOS. Thank you very much, Mr. Einhorn. I failed to mention that you are Deputy Assistant Secretary for Nonproliferation at the Department of State.

Our next witness is Mr. Norm Wulf, Acting Assistant Director, Bureau of Nonproliferation and Regional Arms Control at the Arms Control and Disarmament Agency.

We are pleased to have you, Mr. Wulf.

STATEMENT OF NORMAN A. WULF, ACTING ASSISTANT DIRECTOR, BUREAU OF NONPROLIFERATION & REGIONAL ARMS CONTROL, U.S. ARMS CONTROL AND DISARMAMENT AGENCY

Mr. WULF. Thank you, Mr. Chairman. Bearing in mind your admonition not to be technical, let me explain briefly a couple of technical words that I will use throughout my testimony.

It is generally understood that weapons-usable material is plutonium or high-enriched uranium and the process by which you obtain plutonium is through a reprocessing of spent fuel. The process by which you obtain highly enriched uranium is through enrich-

ment facilities or enrichment plants. I will be making reference to both of these in my comments.

As Mr. Einhorn has outlined, the Clinton administration proposal on fissile material is a comprehensive approach. I will, however, limit my remarks to the treaty banning the production of highly enriched uranium and separated plutonium for nuclear weapons explosives purposes.

I might just state that the idea of a cutoff on fissile material goes back some way. Indeed, one of the earliest proposals was in 1954 by then Prime Minister of Nehru of India. And for the last decade, Canada has introduced a resolution in the U.N. General Assembly calling for a cutoff of weapons-usable material. Last year, for the first time, the United States was able to support that resolution.

It was adopted by consensus and this consensus adoption provides a basis for believing that conclusion of such a treaty is achievable.

By capping worldwide the amount of material available to nuclear weapons, the treaty would place a limit on the number of nuclear weapons that could be developed. In areas like South Asia, achieving such a limit would be an important first step toward the U.S. goal of encouraging a future South Asia free of nuclear weapons and other weapons of mass destruction.

It is important to stress what this proposal would and would not do. It would not require a ban on production of separated plutonium or highly enriched uranium. It would require, however, international safeguards at least on enrichment and reprocessing activities so that the IAEA could verify that any further separation of plutonium or high enrichment levels is not for weapons purposes.

Moreover, I might add that the United States will continue, obviously, its efforts to prevent the spread of reprocessing and enrichment capabilities.

We envision that the treaty would be open to universal membership and to have a chance of gaining acceptance by such states as India and Pakistan the proposal must be truly nondiscriminatory. Therefore, the proposed cutoff treaty would not require states to eliminate past production of highly enriched uranium or separated plutonium.

Some have criticized that aspect of the proposal as de facto acceptance of this past production. This is not the administration's view.

Ever since the Indian detonation of a nuclear device in 1974, it has been the consistent policy of the United States that both India and Pakistan should place all of the nuclear facilities under safeguards and forswear in an internationally binding legal instrument the acquisition of nuclear explosive devices. The most commonly accepted international legal instrument is the Nonproliferation Treaty which now has some 162 parties.

Pakistan has asserted that it will become a party to the NPT if India will, but thus far, India has continued to reject the NPT as being discriminatory. Therefore, U.S. policy has viewed an internationally verifiable nuclear weapons free zone similar to the Treaty of Tlatelolco which applies to Latin America as an acceptable alternative to the NPT. I might add this longstanding U.S. policy remains the policy of the Clinton administration.

It is recognized, however, that achieving a nuclear weapons free zone in the subcontinent will be neither easy nor rapid. Meanwhile, the situation continues to deteriorate as both countries continue to work on nuclear weapons programs and are undertaking preparations to deploy ballistic missiles capable of delivering nuclear warheads.

Thus, the administration views the cutoff proposal as a key step in a multistep process that it is hoped would eventually lead to a South Asia free of nuclear weapons.

Effective verification of a cutoff treaty will be very important and the administration sees the IAEA, or the International Atomic Energy Agency, as the most appropriate agency to carry out such verifications.

We are still exploring the full range of verification possibilities. Some of the factors that need to be considered are the need first for assurance that the material being produced is not weapon-usable or that it is not available for weapons. Second, the negotiability of the verification arrangements must be acceptable to all countries that we wish to become parties to the treaties. And, finally, we need to consider the impact of whatever verification arrangements we can make for the cutoff treaty on the ability of the IAEA to apply safeguards elsewhere.

In conclusion, Mr. Chairman, the fissile material production cutoff treaty is one of several measures designed to reduce growing stockpiles of weapon-usable material. Its verification procedures, including at least safeguards on all enrichment and reprocessing facilities, will take us a step closer to full-scope safeguards for all nonnuclear weapon states.

As a multilateral, nondiscriminatory measure, it will help strengthen the global norm of nonproliferation. Progress toward such an agreement will help U.S. efforts to achieve indefinite extension of the NPT in 1995.

President Clinton's proposal for the multilateral treaty affirms the administration's commitment to limiting stockpiles of excess fissile materials.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Wulf appears in the appendix.]

Mr. LANTOS. Thank you very much, Mr. Wulf.

Our next witness is Mr. Harold B. Smith, Assistant to the Secretary of Defense for Atomic Energy.

We are very pleased to have you, Mr. Smith. You may proceed any way you choose.

STATEMENT OF HAROLD P. SMITH, JR., ASSISTANT TO THE SECRETARY OF DEFENSE FOR ATOMIC ENERGY, DEPARTMENT OF DEFENSE

Mr. SMITH. Thank you, Mr. Chairman.

In the position which you have just described, it is my pleasure to be the executive agent for the Cooperative Threat Reduction (CTR) Program, sometimes referred to as the Nunn-Lugar Program, although I want to emphasize the important role the leadership of the House of Representatives played in designing this very sensible legislation.

Under CTR, I direct the expenditure of funds to assist the nuclear states of the former Soviet Union in dismantling their weapons of mass destruction using American contractors to the greatest extent possible.

This afternoon, in accordance with your letter of invitation, I would like to concentrate on those parts of the CTR program that track and protect the flow of plutonium from Russian weapons to Russian storage sites.

In the Watergate crisis, the admonishment was to follow the money. In assisting our former adversaries in the dismantlement of nuclear weapons, the admonishment is to follow the plutonium and that is exactly what we are doing.

In Belarus, Ukraine, and Kazakhstan, we are assisting in the dismantlement of nuclear delivery vehicles and their launchers at the same time that the Russians are taking possession of the nuclear warheads, which of course contain the plutonium.

We assist in the transport of those warheads by providing armored blankets, specially designed rail cars and safety and monitoring equipment while they are in transit. We do not now assist in the actual dismantlement of the warheads nor for the immediate future should we expect to do so. Such dismantlement would provide sensitive design information, information which we are unwilling to give the Russians and vice versa.

What we do provide are specialized containers for storing the plutonium triggers in as safe a manner as possible. However, our tracking of the plutonium does not end there. We are working with the Russians to design and equip, and with the support of Congress, we intend to assist directly in the construction of appropriate storage facilities.

I would like to pause for a moment in following the plutonium to note the great step forward that was made last week with regard to those facilities, a step that you have already alluded to, Mr. Chairman.

Up until last week, in accordance with the Markey Amendment, the CTR program could not continue to assist the Russians with respect to construction of the storage facilities until the Russians certified that they were no longer planning to separate plutonium from the production reactors at Tomsk and Krasnoyarsk.

In negotiations last week, Viktor Mikhailov, the Minister for Atomic Energy of Russia, and Secretary O'Leary announced that the Russians would meet the conditions specified in the Markey Amendment. Therefore, we will proceed now with our assistance in designing a storage facility and we can at the same time know that new plutonium will not be entering the Russian arsenal.

Minister Mikhailov and Secretary O'Leary also announced their intentions to host mutual inspections by the end of this year of present facilities containing plutonium removed from nuclear weapons. The U.S. Government is considering ways to carry out those inspections. One approach could use a technology developed in the United States by the Department of Energy and by the Russian Ministry of Atomic Energy.

This equipment would confirm the presence and amount of plutonium in sealed containers without divulging nuclear weapons design information. Therefore, each side would gain increased con-

fidence that nuclear weapons are indeed being dismantled and that a reliable inventory of the resulting material could be accomplished in a nonintrusive fashion. I am pleased to report that technical experts will meet by May 16 to define the procedures for those inspections.

In short, Mr. Chairman, we cannot dismantle the Russian weapons, but we can be assured that they are dismantled and the fissile material removed from them is neither recycled into new weapons nor allowed to enter the proliferation stream.

I think one can begin to look forward to an era when plutonium formerly in Russian warheads will be under at least bilateral inventory inspection in facilities that we will help to construct that are protected against theft and sabotage.

It may well be that at some future time the Russians and Americans will find a way to provide disposal of that plutonium in a manner that will ensure that it can never be used for nuclear weapons. A recent report by the National Academy of Sciences encourages such disposition and sets forth sensible guidelines for its accomplishment.

Because of the critical impact of such a move on the national security of the United States, I can assure you that the Department of Defense will play a key role.

Until that time, we will continue to execute the Cooperative Threat Reduction Program in the manner I have described which follows the plutonium in a manner that will accrue to the safety of the United States, of Russia and indeed the world.

Thank you, Mr. Chairman. I will be pleased to answer any questions you may have.

[The prepared statement of Mr. Smith appears in the appendix.]

Mr. LANTOS. Thank you very much, Mr. Smith.

Our next witness is Mr. Robert W. DeGrasse, Director, Surplus Fissile Material Control and Disposition Project at the Department of Energy.

We are pleased to have you, sir.

STATEMENT OF ROBERT W. DeGRASSE, JR., DIRECTOR, SURPLUS FISSILES MATERIALS CONTROL AND DISPOSITION PROJECT, DEPARTMENT OF ENERGY

Mr. DEGRASSE. Thank you, Mr. Lantos. I appreciate the opportunity to appear here before the subcommittee.

On behalf of the Secretary, I would like to thank you for your kind words regarding some of her recent decisions and actions and the kind words as well of my colleagues from the other agencies. We are pleased to have been able to work closely with other departments of the government to ensure that we have been able to achieve some very important agreements in the area of fissile material control recently.

In addition to the items you mentioned, particularly the letter regarding the Japanese utility's use of Mr. Pluto, I would like to say that we believe and I think the Secretary would say that upholding ethical and moral standards is the strongest basis for developing public policy action. I think the Secretary believes that very strongly.

We think, as well, that the President's policies regarding nonproliferation and fissile material control and disposition provide a strong basis for developing sound international policy in this area.

What I would like to do very briefly since my colleagues have covered many of the subjects that you have referred to in your testimony and not wanting to repeat what has already been said, I would like to focus on two issues. One, I would just like to make it clear that the Department of Energy, over the last few months, has recognized that because of the dramatic changing mission of our Department after the end of the cold war we were, after all, the stewards and continue to be the stewards of our nuclear weapons and the agency that was responsible for research, development, production and dismantlement of those weapons. Now the dismantlement piece is one of the most important activities of our Department.

Because of the very dramatic changing nature of our mission, we recognized over time that we have not been well organized to really deal effectively with the control and disposition of nuclear materials. Based on that understanding, the Secretary this last month decided to develop initially a matrix organization within the Department that would draw from each of the key groups that have expertise in this area, to focus the efforts of our Department on this very important national security issue. We view this as an important mission, a continuing mission of the Department and the Secretary is committed to making nonproliferation a key element of her activities during her tenure in the Department.

I would also like to focus for the rest of the time I have remaining on the issue that you raised regarding the civilian accumulation of fissile materials and to point out first that the administration and the Secretary, in particular, took one important action in this area through the fiscal year 1995 budget process by deciding to terminate the actinide recycling and advanced 454 breeder program and terminating the program at Argonne East and West.

This is a very controversial decision. One that was based on the fact that the breeder program in this country, held out the promise of increasing the value of uranium 100 times through recycle. As far back as the Carter administration, there was recognition that this was very unlikely to pan out in the future and in the recent past.

It has not in fact panned out internationally and, in addition, the process of continuing this technology in the hopes that we would use it as a way of burning actinides and reducing waste only gave further support to the notion that somehow we might get to that future world.

So that decision in part, from the Secretary's understanding, was a key element in trying to move forward in efforts to control the international accumulation of these materials.

Thinking about this problem for a moment, we have to remember that there is at least 80 to 90 tons of excess separated civilian plutonium in stores around the world today. We are accumulating this separated material somewhere in the neighborhood of 5 to 10 tons a year because about 10 to 20 tons are being separated in mixed oxide fuel fabrication and burning is only happening at some small

portion of the separation rate. So we continue to accumulate separated materials.

Now, that is in addition to the substantial amounts of material, 600 to 700 metric tons total of material that is either separated or in spent fuel in the civilian arena and which is being created at the rate of 60 to 70 tons per year.

Now, those numbers swamp the amount of material that both the Russians and our Nation has in separated amounts for weapons purposes and so clearly the dimensions of this problem are significant and important and we recognize the urgency of working on ways of dealing with that problem.

Now, going back to the history of the Carter administration, there were efforts made then to try to discourage other nations, through the consent rights approach, from going forward with nuclear programs. And for a number of reasons, those efforts were not very successful. And really, I think, the basic underlying concern is the concern about attempts to interfere with decisions of other nations.

Now, where does that leave us today and what can we do?

If consent rights are going to be a difficult issue for us to undertake, then we have to look at other options. And one approach may be to examine possible areas where there is confluence of interests between nations that have a need to ensure their future energy security and also to deal with their waste problems in an expeditious and reasonable manner. And through the Department of Energy, we are looking at options that can be developed to try to discourage additional plutonium activities.

But this is a knotty problem. It is not an easy one to solve. We think there are a number of things that can be done. I would point to one in the report that you will hear more about this afternoon, Dr. Brian Chow in his report done for the RAND Corporation and for the Department of Defense. The study pointed to the possibility of some sort of a plutonium bank in which we would look at plutonium as having a couple of different types of value. One, it has an obvious energy value.

Now, it is more like shale oil than it is like oil because it is hard to extract and there is general agreement that the economics of extracting it are poor at this time, particularly in the United States but even abroad. But there is also very great value and the Nunn-Lugar Program is an example of the value that Congress has placed on trying to protect and control nuclear materials so we have acknowledged as a nation that there is value in trying to protect against this material getting out.

We should, I think, look at the notion of using some efforts that encourage positive behavior and I would encourage discussion of this plutonium bank option as one possible way of trying to begin to work on this problem.

So thank you very much, Mr. Chairman, for the opportunity to appear today and I hope this has been helpful to you.

[The prepared statement of Mr. DeGrasse appears in the appendix.]

Mr. LANTOS. Thank you very much, Mr. DeGrasse.

I have a couple of questions that I would like to offer to the panel and ask any or all of you to respond and then I have some specific questions directed to individuals.

Is there any evidence to suggest that what we have come to call rogue regimes are actively pursuing Russian plutonium and, if so, which countries are we talking about?

Mr. Einhorn.

Mr. EINHORN. Mr. Chairman, it is hard to get into the subject in open session but, yes, we do have evidence that what you call rogue regimes are seeking not so much plutonium although that would not be excluded but various sensitive goods and technologies in parts of the former Soviet Union, including Russia. We do have evidence of that and it is worrisome. In closed session we could go into greater detail. Thank you.

Mr. LANTOS. That sounds fine.

Mr. Wulf, any comment?

Mr. WULF. No.

Mr. LANTOS. Mr. Smith, any comment you would care to make?

Mr. SMITH. No further comment.

Mr. LANTOS. Are there any specific legislative measures you believe would help address the proliferation threat from surplus plutonium?

We will start with you, Mr. Smith.

Mr. SMITH. Mr. Chairman, the Department of Defense is only responsible for plutonium while it is in the weapons under our control. We are very satisfied with the security we have over our own weapons and we see no further need for legislation there. We are dismantling those weapons at an impressive rate that fully taxes DOE's, Department of Energy, Pantex facility.

But when we take our weapons out of the stockpile, we then transfer them to the Department of Energy and the surplus plutonium, of course, is their problem. And I am happy for it. Again, in that case, I do not see any need for legislation. The process is going very smoothly.

Mr. LANTOS. Would either of the rest—Mr. Wulf, would you care to make a comment?

Mr. WULF. Senator Glenn has put forward a proposal to provide for sanctions for some activities related to nuclear exports and certainly the administration supports this legislation and thinks it is a good idea. My understanding is that it is going forward in both houses at the present time.

Mr. EINHORN. Mr. Chairman, in the various agencies' authorization bills, we have requested funding to support various nonproliferation related activities. The State Department has its own nonproliferation fund and here it would be important for us to have the kind of resources which we could use to help strengthen in Russia and other states of the former Soviet Union export control systems, materials control and accountancy systems, to strengthen international safeguarding efforts such as the IAEA undertakes and so forth. We think that kind of legislative support would be most welcome and useful.

Thank you, sir.

Mr. LANTOS. Mr. DeGrasse.

Mr. DEGRASSE. I would just underline the fact that the administration has asked for additional funding for the IAEA and this is a particularly important element of our efforts, I would say. I encourage your support.

Mr. LANTOS. Mr. Smith.

Mr. SMITH. Mr. Chairman, I would like to comment in reference to my testimony. The CTR program appears to be very well received and very generously funded. We are going to be making additional requests upon the Congress for some major projects. One of those is the storage facility to which I alluded. Your support would be very much welcomed, as well as that of the committee.

Mr. LANTOS. Secretary Einhorn, how much can we hope to reduce, or better eliminate, stockpiles of plutonium when we are not willing to seek revision of existing commitments?

Mr. EINHORN. I am not sure, Mr. Chairman, what you mean by existing commitments. If you are referring to commitments we have provided to countries like Japan regarding our willingness to provide in advance consent to their sending their fuel to EURATOM for reprocessing. If that is the kind of commitment—we believe that it is important to fulfill such commitments.

We believe that Japan is a responsible handler of its civil energy resources and we think that reneging on U.S. commitments to Japan and other states would lead to a confrontation with these countries, would lead to greater independent actions by these countries which in the long run could deserve our nonproliferation objectives.

Mr. LANTOS. Mr. Wulf, the United States is willing to push ahead in negotiating a comprehensive test ban despite the resistance of some of our principal allies. Why are we not willing to be as forceful with respect to civil plutonium use?

Mr. WULF. Well, I think it is fair that there are some reservations about a comprehensive test ban in the U.K. and France, but thus far there has been very good cooperation by both in the Conference on Disarmament in the negotiations of a comprehensive test ban.

On civil use of plutonium the question really comes down to whether we should seek to coerce or seek to persuade our principal allies.

If I could just add to what Mr. Einhorn said, the Japanese recently took the decision, which we applauded, to put off construction of a second large scale reprocessing plant from 10 or 20 to 30 years.

The Japanese case indicates that through examination of economic and other aspects of civil use of plutonium, allies will come to the conclusion themselves that the plutonium route is not the way to go.

Part of the problem, obviously, is that some states have spent billions of dollars on these programs already and they are unwilling to sacrifice that money. They will try to at least recoup some of their investments. But ultimately we cannot, in my judgment, coerce them, successfully, into abandoning plutonium.

Such coercion was tried once and I failed. I suggest we are much better off trying to work with our allies to persuade them over time to take another path.

Thank you.

Mr. LANTOS. Mr. Smith, an agreement was reached last week to shut down the remaining reactors in Russia that produce weapons grade plutonium. Is that correct?

Mr. SMITH. That is indeed correct, Mr. Chairman.

Mr. LANTOS. How soon will those facilities be closed?

Mr. SMITH. The agreement that was reached was to live up to the Markey Amendment, to which Mr. Mikhailov agreed. That means that they must actively plan to shut down those reactors. Excuse me. To stop the plutonium separation. And they must plan to now close down those reactors.

I do not think we have an agreement yet, although I will defer to Mr. DeGrasse, that actually states the date on which they will stop the separation plants.

Mr. LANTOS. Mr. DeGrasse.

Mr. DEGRASSE. Thank you, Mr. Chairman.

In regard to this agreement, there are some important aspects we need to remember. They have essentially agreed that they will terminate the reactor operations after they have established alternative energy sources.

Now, they have also——

Mr. LANTOS. What kind of a time line are we looking at?

Mr. DEGRASSE. They are hoping that this would be done by the end of this century. Now, that is the reactors.

Now, Minister Mikhailov on the other hand made the commitment to end reprocessing by the end of this year. He said that publicly in his press conference afterwards and he said that to a number of others during the process of the negotiations.

Now, our understanding is that they are hoping to be able to probably change the fuel type in the reactors so that they would no longer need to reprocess, so that they would then be able to avoid producing any further plutonium but still run the reactors for their district heating and electrical requirements in Tomsk and Krasnoyarsk. So that is at least, reading between the lines, our understanding of where this agreement currently stands.

Mr. LANTOS. When the Russians close the last of these reactors, will there be any remaining nations producing weapons grade plutonium?

Mr. DEGRASSE. That is an issue I believe that we would need to—I am not absolutely sure and I think we would need to ask our intelligence people on that to make absolutely certain. But for weapons purposes, obviously civilian light water reactors produce plutonium every day as we are speaking but the question is what is being separated for weapons use. And, again, we have been engaged in some discussions with the North Koreans about exactly that problem. So certainly there are other nations at issue as well out there.

If you would not mind if I could try to make an effort to try to answer an earlier question or assist in adding to the issue related to consent rights. I think it is important and in our testimony we indicate there is a difference between the suppliers of reprocessing services and the people who use it, that use these reprocessing services. And I think there is an opportunity, given the fact that what we have now in Cogema and THORP, the two major reproc-

essing facilities, are in many cases or primarily have already been paid for up front by commitments on the part of utilities to have take-or-pay contracts for providing rods to be reprocessed and the returning the plutonium.

The question is are there effective economic mechanisms to essentially discourage the users of such services from needing them.

Now, there is already some cost associated with that but potentially the two reprocessing operations would not be badly damaged and the users of the services might find better alternatives. And so, that is where we are seeking and looking at potential alternatives for the use of—to try to discourage it, instead of trying to run the process of really creating unnecessary conflict between allies over consent right issues which are quite complicated.

Mr. LANTOS. Would any of you care to add anything to what you have said thus far, gentlemen?

If not, let me indicate the request of the ranking Republican member of the subcommittee, my colleague Congressman Bereuter, I would like to submit to the Department of Energy several questions for the record and ask you to submit your responses to these as expeditiously as possible.[1]

Your presentations here and your prepared statements are of great value to the subcommittee and I want to thank all of you very much for coming.

We will now move on to the second panel comprised of Dr. Catherine M. Kelleher, Senior Fellow, Foreign Policy Studies, at the Brookings Institution; Dr. Brian Chow, National Defense Institute at RAND; and Mr. Paul Leventhal, Director, Nuclear Control Institute.

If I may repeat my earlier admonition, your prepared statements will be entered in the record in their entirety and I will be most grateful if your oral presentation will be as nontechnical and as comprehensible to a lay audience as possible. We are very grateful to all three of you for appearing.

We begin with you, Dr. Kelleher.

STATEMENT OF CATHERINE M. KELLEHER, SENIOR FELLOW, FOREIGN POLICY STUDIES, THE BROOKINGS INSTITUTION

Ms. KELLEHER. Mr. Chairman, may I say how pleased I am to be here, to have the opportunity to present the views of the Committee of International Security and Arms Control of the National Academy of Sciences.

As you know, in the winter CISAC, as the committee is called, released a report on an 18-month study which had been concerned with the management and disposition of excess weapons plutonium, looking both at the short-term problem, the interim options and long-term disposition.

The study was conducted primarily under the sponsorship of the National Security Council and the Department of Energy and was led by Professor Wolfgang Panofsky of Stanford.

A second panel which has yet to finish its report is called the Reactive Panel, which is looking specifically at reactor options and

[1] The responses appear in the appendix.

primarily concerned with long-term disposition and we expect that report to be issued shortly.

The CISAC report covers many phases of the excess weapons plutonium problem but I would like in my remarks today and in the written testimony I have submitted to address two particular problems, the first, a proposed cutoff in the production of fissile material for weapons and, secondly, our ability to safeguard and secure quantities of plutonium and HEU that are now becoming available.

I would like also at the end of my remarks to say a few words that are personal about the implications that it seems to me can be drawn from our study to the global problem of the management of all kinds of plutonium.

We see, that is, we the committee see the plutonium production cutoff as a crucial component of the new broad regime of the control of all fissile materials which should evolve. By the year 2000, over 100 metric tons of plutonium will have been declared excess for weapons purposes as a result of the START agreements.

These fissile materials, however, are only a small fraction of the world stocks of fissile materials, exacerbated by other sources, not just of plutonium but also of HEU which include things that are held in reserve for weapons production, materials currently in reactors, materials stored in spent fuel from reactors and materials that have been reprocessed.

Plutonium from all of these sources, all of these sources I repeat, can eventually be used in producing weapons. It takes only several kilograms of plutonium, fewer if it is separated weapons grade material, somewhat more if it is reactor grade material, to produce a bomb.

Therefore, all weapons usable material, plutonium of any grade, civilian or military, whether separated or not, should figure in any credible plan of fissile material control and disposition.

We have heard in the first panel about civilian stocks of plutonium and the sources of decisions in Japan, Britain and France that led to present plans to use these materials for civilian power applications.

It is absolutely clear, however, now that these policies do contribute to an over supply of these materials for which there is no simple long-term or even short-term storage or disposal solution.

Moreover, the vulnerability of these materials to attack or diversion poses significant new risks in terms of the nonproliferation goals that have taken on greater importance.

For Russia and the United States in an initial phase, the committee envisions the development together in the shortest time possible of a reciprocal regime of declarations, agreements to in fact cutoff the production of fissile materials for weapons purposes and the monitoring and verification of subtractions from the stocks that are now available for military use.

Moreover, the committee very much recommends that all, or perhaps if not all, a substantial fraction, of the fissile materials extracted from weapons declared excess be in fact committed to most peaceful uses if not to retirement as a whole.

This will indirectly serve as a first step toward a global regime but in the short term, given the urgency of the present control

problem in the former Soviet Union, it will directly serve the key security objectives of limiting the risk of theft or diversion, limiting the risk of reversibility or breakout and strengthening bilateral efforts and cooperation in arms reduction and toward nonproliferation.

A few elements of a broad regime are in fact already in place and you heard much about them in the earlier panel. But there is still far more to be done and there is great urgency to these tasks, an urgency not always recognized in present discussions in this country or in the pace of implementing measures following expressions of congressional intent.

The committee found that the risks and threats associated with loosened control over weapons in the former Soviet Union constitute a direct clear and present danger to the national security of the United States, therefore achieving substantial improvements in the management of controls of these weapons on a reciprocal basis since that is the basis that is necessary as one of the first priorities for American policy.

An important achievement was reached in the three agreements that were announced on March 17 but there is still more that can be done in terms of expanding not just the material basis on which bilateral cooperation continues but in fact the resources that are available, both financial and human, devoted to these tasks.

Moreover, it is too easy in this as in other issues to let the complex politics of related questions and what I believe and the committee believes are secondary questions such as the future of nuclear power worldwide or the need for environmental safety to take precedence over the first priority, which is to shut down all fissile material production as soon as possible and to bring all existing weapons usable stocks under control.

We see finally the evolution on this of a worldwide regime which would involve declarations of weapons holdings so that in fact universal reporting on fissile materials would include and allow the tracking of all imports and exports as well as of domestic production.

On the second point, the theft and diversion question, one can only say that while there have always been anxieties about theft and diversion, the situation in the former Soviet Union at present represents a quantum jump in the amount of risk and the dangers involved.

The time to ensure adequate arrangements for security and accounting is yesterday, as many of the Russian officials themselves are the first to say.

Every day that goes by, every weakening of the basic custodial and control arrangements in the former Soviet Union adds to the risk that fissile materials may be stolen, diverted and wind up in the hands of potential proliferators.

The agreements so far go quite a way but they are not sufficient in that they only have to do with weapons materials declared excess by national decision. They do not provide adequately, we believe, for the safe and secure storage of all potentially weapons usable materials.

The United States is working hard but needs to work harder with Russia and with Ukraine, Kazakhstan and other former So-

viet states to be sure that there is an inclusive accounting and control regime based on adequate storage provisions.

Moreover, while one speaks lightly of invoking IAEA controls, there are insufficient resources now made available to IAEA and perhaps even will still be insufficient under the present request since it is framed in relatively narrow terms to in fact carry out a responsible part of this regime.

CISAC in fact recommends an urgent comprehensive approach at a significantly higher level of funding with an emphasis on cooperation with Russia and other nuclear weapon states in addressing the most urgent and immediate risks.

[The prepared statement of Ms. Kelleher appears in the appendix.]

Mr. LANTOS. Thank you very much, Dr. Kelleher.

Our next witness is Dr. Brian Chow, senior physical scientist of the National Defense Institute at RAND.

We are very pleased to have you, sir.

STATEMENT OF BRIAN G. CHOW, SENIOR PHYSICAL SCIENTIST, NATIONAL DEFENSE INSTITUTE, RAND

Mr. CHOW. Mr. Chairman, thank you for inviting me to testify here this afternoon.

In my oral presentation, I will focus on three areas:

First, what are the problems arising from the separation of plutonium?

Second, are the steps being taken or proposed by the United States and other countries sufficient to stem the plutonium tide?

And, third, what other measures need to be implemented by the United States and other countries?

Now I would like to comment on the first area, namely, the problems of separated plutonium.

Both military and civilian separated plutonium face two common problems. First, it is the diversion of plutonium by terrorist groups, as Dr. Kelleher just mentioned. An economy involving extensive use of plutonium would make it much more difficult for the International Atomic Energy Agency to safeguard so much plutonium in so many places, especially the transportation network, on land, at sea and in the air.

Second, it is the seizure of plutonium by host countries. The IAEA or any other organization cannot possibly prevent countries from seizing plutonium that is located within their own territories. We should recognize this point. It does not mean IAEA is not useful, but it means we must create an environment so that IAEA can do its job.

In RAND's recent study, we found that plutonium use will be uneconomical for the next 30 to 50 years or even much longer. Moreover, there will always be enough plutonium in the spent fuel to support even an optimistic plutonium-based breeder buildup in the event that this kind of breeder is needed unexpectedly. Therefore, countries can postpone their plutonium activities without much economic sacrifice.

Now I would like to comment on the second area, namely, the adequacy of current proposals in dealing with separated plutonium.

President Clinton has wisely considered limiting nuclear proliferation to be a top priority item and has announced several worthy initiatives. But more needs to be done. For example, President Clinton's proposal to eliminate, where possible, plutonium stockpiles might be understood or misunderstood to mean merely using up separated plutonium fast. In that event, the policy might end up, instead, in sanctioning and encouraging plutonium use which we do not want.

Similarly, halting fissile material production for weapons only would not, I emphasize would not, prevent countries from continuing their nuclear weapon development, because they would simply claim that the production is for civilian nuclear power programs.

As you know, Mr. Chairman, North Korea is already claiming that.

As to dealing with plutonium from the former Soviet Republics' dismantled nuclear weapons, storing it in the Republics under IAEA and/or bilateral safeguard, as many people inside and outside of the government have proposed would be inadequate, because it does not prevent Russia from using the weapon-grade plutonium to reconstitute its massive nuclear arsenal in the event that the political situation there changes for the worse.

Finally, I would like to comment on the third area, namely, additional measures to deal with separated plutonium.

Although we do not know whether Russia is willing to sell us its weapon-grade plutonium as it is with its highly enriched uranium, the United States should make an offer now and with its best efforts. Purchasing it or taking it out of the former Soviet Republics is the best way for us to deal with their weapon grade plutonium.

There is, however, a distinct possibility that Russia would refuse to let its weapon-grade plutonium leave the country. Then, burning it is better than storing it.

As to discouraging worldwide use of plutonium, I mean, of course, both military and civilian, the United States is unlikely to be successful by offering too many sticks but too few carrots.

The United States needs to develop carrots in two areas. First, it needs to offer an alternative to plutonium that still promises countries energy security because that is the major concern. We must offer an alternative.

Second, the United States needs to propose international arrangements that guarantee countries, even if they forego plutonium activities now, will still share the benefits of plutonium-based reactors if they ever turn economical.

I do not have time to go over the whole program but I have spelled out such a program of carrots in the prepared statement and in our RAND report. I, however, want to mention one idea which is too new to be even included in the prepared statement.

The idea is to allow countries such as Japan to have ownership, although it is a passive one, in plutonium facilities in nuclear weapon states such as U.K. and France, if nonnuclear weapon states agree not to pursue such sensitive activities themselves. U.K. might love it because, as you know, of the poor financial prospects on its THORP reprocessing plant.

In conclusion, if the world continues its past course, many countries will be situated ambiguously and dangerously near the nuclear threshold.

Therefore, Mr. Chairman, the United States should lead an international effort to stem the plutonium tide.

Thank you.

[The prepared statement of Mr. Chow appears in the appendix.]

Mr. LANTOS. Thank you, Dr. Chow.

Our next witness is Mr. Paul Leventhal, Director of the Nuclear Control Institute.

We are pleased to have you, sir. You may proceed any way you choose.

STATEMENT OF PAUL LEVENTHAL, PRESIDENT, NUCLEAR CONTROL INSTITUTE

Mr. LEVENTHAL. Mr. Chairman, thank you very much for the invitation to testify today.

I have prepared a lengthy statement with attachments, and I appreciate your offer to put them in the record.

Mr. LANTOS. It will be included in the record, as are all others.

Mr. LEVENTHAL. The first thing I would like to say, Mr. Chairman, is how much I welcome your holding these hearings. It has been some time since a hearing has been held on U.S. plutonium policy or lack thereof, and I would simply urge you to continue the oversight effort. It is quite important.

I think there is some change in the executive branch, more so in some agencies than others. There are some important negotiations that are going on that are within the purview of your committee that have a direct bearing on the plutonium question, specifically the run up to and the negotiation of the extension of the NPT, the fissile cutoff convention that was testified to by the first panel, and expiration of the U.S.-EURATOM and U.S-Swiss nuclear cooperation agreements, which do provide another opportunity for the administration and for the Congress to take a fresh look at what is going on.

As the last witness, I am in a position to react to some of the things said by other witnesses, and I will take that opportunity. Most of these comments are also reflected in my testimony.

Our principal recommendation is to take cognizance of the fact that the two studies that have just been described by my fellow panelists here each go to great lengths to point out the need to deal with civil as well as military plutonium. Despite some of the statements made by the first panel, we do not have a coherent policy on plutonium. We have a comprehensive policy on fissile material, but it is largely rhetorical.

However, we should not downgrade the value of rhetoric. This administration in contrast to the previous two is prepared to at least discuss these matters and admit that there is a problem. But in substantive terms there is no difference, and I emphasize no difference, between the plutonium-use policy of the Reagan and Bush administrations and that of the Clinton administration as it applies to the reprocessing and plutonium use activities of Western Europe and Japan and now Russia, as well.

My principal recommendation is that since the policy was enunciated by the Clinton administration prior to the release of the RAND and National Academy studies that there should be a reopening of the nonproliferation policy and of the fissile material policy within that policy to take cognizance of and to address the recommendations made in those two studies. I think it is important that the executive branch be asked to make that kind of a policy review.

The principal problem we see with the policy and why we call it incoherent is that it lacks the same tight fit between civil and military aspects of plutonium that the present administration's policy does establish with regard to highly enriched uranium. The policy should be praised for the rather bold steps that have been taken to finally get bomb-grade uranium out of commerce.

It is remarkable, though, that with a perfectly straight face the administration can claim that they should be pursuing a different policy with regard to plutonium because of the anticipated resistance from our closest allies and trading partners. We often hear that we should not let "the perfect become the enemy of the good," that we have to do the best we can. That is a lame excuse, in my view, given the high proliferation risks of plutonium.

With regard to the fissile cutoff convention negotiation, for example, there is an expressed concern that the moment the civil plutonium question is raised, that is when we lose our allies, particularly the French and the British and the Japanese, on attaining what is regarded as nonetheless an important agreement to cutoff military production material.

We would argue that a cutoff of military material alone does not get you anywhere because the way the convention is now conceived and being advocated by the U.S. Government, it would permit continued production of bomb-usable nuclear material so long as it is placed under safeguards. And, further, full-scope safeguards would not apply, so existing stocks in non-NPT states would not be affected.

I think you will not have much of a regime if that is what you are going to get at the end of the negotiation. The administration says, do not let the perfect become the enemy of the good. You have to ask yourself, well, how good will be the regime that will result?

And the effectiveness of the regime is dependent entirely upon the adequacy of the safeguards that will apply to the bomb-grade material that can still be produced, can still be stockpiled under this fissile cutoff regime.

And I think we have heard testimony on this point already, but let me reiterate that the safeguards are very limited, both from a technical and a political standpoint and even if a nation chooses not to divert material and lives up to its commitment, it will nonetheless acquire a stockpile of weapons-usable material that in the event of changed circumstances they would be able to convert rather promptly to weapons in the future.

It is often argued that major industrial states do not do things like that. If they want to go nuclear, they are going to do it the way other states have done it in the past. They will have a dedicated program, they will let everyone know they are doing it and

eventually they will have the bomb. But in political terms, that does not make sense.

In a crisis situation where a nation feels that it must have nuclear weapons in a hurry, in that kind of a circumstance, safeguards will be violated, civil stockpiles will be seized and you could have a very messy and dangerous situation in the world.

When you multiply that type of danger times the amount of materials that will come into commerce, if the U.S. policy continues and we permit eventually hundreds of tons of plutonium to be separated from spent fuel, we are getting ourselves on a slippery slope by advancing a regime that is not manageable, that is not workable.

And that is what I think this committee needs to look at, how workable and manageable is the kind of regime that would exist if the convention that is being discussed is actually agreed to.

We also have recommendations on pursuing the extension of the NPT in a fashion that addresses the plutonium issue without necessarily sabotaging the whole effort to extend the regime indefinitely or for an extensive period. And one of my submissions is a legal analysis to show that under the existing terms of the treaty it is possible to interpret the treaty in a way that bars the further production of weapon-usable nuclear materials because they are not economical, they are not readily safeguarded, they do not contribute significantly to waste management, so all of the presumed peaceful uses no longer apply under a new set of circumstances that could not have been fully anticipated 25 years ago, and therefore the treaty can be and should be implemented differently, as provided in the language of Article IV. And we offer that as an approach that should be seriously considered.

The final initiative that we propose is to enter into the ongoing negotiations with EURATOM, the European Atomic Energy Commission, and with Switzerland to revisit issues that were addressed in 1987 when the U.S.-Japan agreement was negotiated.

I would remind you, Chairman Lantos, that a majority of this committee sent a letter to President Reagan, as did a majority of the members of the Senate Foreign Relations Committee, saying that that agreement was unlawful under the Nonproliferation Act and should be withdrawn and renegotiated, or resubmitted with a waiver of the requirements of the act.

The Reagan administration rejected that view, even though the Controller General and the CRS American Law Division agreed, and I think these issues still apply and are worthy of a fresh look right now. I think the negotiations might go rather differently than they would otherwise go if there were a strong oversight role played by this committee.

[The prepared statement of Mr. Leventhal appears in the appendix.]

Mr. LANTOS. Thank you very much, Mr. Leventhal.

Mr. LEVENTHAL. Thank you, Mr. Lantos.

Mr. LANTOS. And I want to thank all three of you.

I have a couple of questions, if I may.

SAFETY OF RUSSIAN REACTORS

How vulnerable are Russian reactors to accidents, in your view? Any of you.

Are these reactors vulnerable to damage, destruction or theft by terrorists?

Mr. LEVENTHAL. Well, I could take a first crack at that. There is a lot of concern about the overall safety of the Russian reactors, both the RBMK type, that was the Chernobyl, and the VVER which is the light water reactor. And efforts are being made to upgrade the safety and efforts are also being made, for example, with the two production reactors that may shut down to provide non-nuclear alternatives for powering those facilities and generating heat and electricity without using nuclear fuel.

The point about the vulnerability of reactors to terrorist acts is a very important one and one that tends not to get a lot of attention and it applies as much in this country as it does to Russia and other countries and the Nuclear Regulatory Commission has just proposed a rule that our organization and another in California, the Committee to Bridge the Gap, has been advocating for years, namely, to put protective barriers to prevent a World Trade Center type intrusion and bombing of a reactor because they are vulnerable.

The other point that is worth mentioning, and it does apply to the North Korean situation, is that in a conventional war, reactors could become targets and you could have nuclear consequences from a conventional war and I think that is a very strong reason why a lot of restraint is being exercised by the United States in dealing with the North Korean situation which is a very difficult one.

I just wanted to make those points.

Mr. LANTOS. Very good. Dr. Kelleher.

Ms. KELLEHER. I just wanted to add, Mr. Chairman, that one would not have to even go so far as to worry about the reactor because for most of the civilian reactors in Russia the question of the security of the spent fuel rods, those that have been pulled from the reactor, is itself a very large question and that there are, both in terms of the physical circumstances in which these fuel rods are kept, namely the pools, and in fact the physical barriers to intrusion into those pools, serious questions that have been raised both by American visitors from the administration and by European visitors as to whether or not they are in any sense adequately safeguarded.

Now, one does need a certain amount of care and knowledge to in fact make an explosion from the plutonium contained in a spent fuel rod but still it is not beyond the capacity of a number of technicians and scientists and some perhaps even in the service of countries who wish to proliferate.

Mr. LANTOS. Dr. Chow.

Mr. CHOW. My fellow panelists covered the topic so comprehensively that I have very little to add.

Mr. LANTOS. Well, you are all very helpful. Let me pursue this in a slightly different fashion.

ACQUISITION OF WEAPON-USABLE NUCLEAR MATERIALS BY TERRORISTS

Is there any publicly available evidence to suggest that terrorist organizations have sought to acquire weapon-usable nuclear materials?

Mr. Leventhal.

Mr. LEVENTHAL. There have been a number of press reports of black marketeering in materials and most of them when checked out indicate that very small samples of material, sometimes not of weapons grade, sometimes of weapons grade, have been offered for sale as a suggestion that greater amounts are available.

But I am not aware on a nonclassified basis, and I only have access to unclassified information, that there has been a major transaction whereby a weapon or weapon-usable materials have gone to terrorist organizations or rogue states.

But the world we live in today is such and the situation in Russia today is such that very close scrutiny is required and unfortunately one cannot rule out by any means the possibility of that happening.

Mr. LANTOS. Dr. Kelleher.

Ms. KELLEHER. I, too, have only followed the accounts in the press. To my knowledge, there are two specific incidents that have become public and this more again as substantiated by the European Community sources than from those in the United States. One involved naval reactor fuel which really was not a critical question, the second involved very, very small amounts.

The problem, however, is that there is certainly documentation of buyers seeking such materials and one really has the sense that they have covered the market rather completely. And while there is no evidence that they have been successful in their search, I suspect that one is talking about such a large area and such a large number of potential buyers that one really cannot rely on publicly available data.

Mr. LANTOS. Dr. Chow.

ACTIVITIES OF RUSSIAN MAFIA

Mr. CHOW. Of course, there are buyers seeking those materials, but what I learned recently is from the sellers' side. The Russian Mafia, which conducts many illegal activities, is now very interested in obtaining these weapon-grade materials for sale. When an organized crime enters into the picture, the problem can become much more serious very soon.

Mr. LANTOS. Dr. Chow, you recommend that we purchase from Russia the plutonium recovered from dismantled weapons of the former Soviet Union. What is your ballpark estimate of the cost involved in such a transaction?

Mr. CHOW. To start with our own RAND assessment, we found that plutonium has no economic value to the former Soviet Union. So in theory, we do not have to offer anything. But, to be realistic, they could value the plutonium differently. So, to answer your question, we should offer on the order of $1 billion for that 100 metric tons of plutonium.

LEGISLATIVE SOLUTIONS

Mr. LANTOS. Finally, let me ask, are there any specific legislative measures that any of you would suggest would be helpful to deal with this enormously important issue?

Mr. LEVENTHAL. I am always reluctant to suggest legislation because I know how difficult it is to get it enacted in the form that you originally propose it. And particularly in the nonproliferation area, having done some of this work myself on the Senate side some years ago.

I would say in general terms in keeping with my statement earlier to keep a close eye on the negotiation of the U.S.-EURATOM agreement and on the convention for a cutoff of fissile material and be prepared to direct the executive branch to do what you want it to do if it seems unwilling to do it.

Mr. LANTOS. So you are basically saying that it is more oversight or active oversight, rather than additional legislation that is called for.

Mr. LEVENTHAL. I think at this stage that is true. There was effective legislation passed in the last Congress calling for a cutoff of export of highly enriched uranium and I think there was an opportune time to do that and it really paid off because it helped get the whole HEU cutoff regime back on track.

Plutonium is a much more sensitive issue because of the sensitivities of the Europeans and the Japanese but I do believe that our patience is being tested in the sense of the extent to which we are being jerked around in anticipation of a bad reaction. I mean, we are lecturing Japan on economic issues all the time without risking the overall relationship. It makes things more difficult but nonetheless we are able to do it. Why can we not raise the plutonium issue?

And I think through the oversight process you can help the administration raise that issue and surely encourage the Department of Energy which seems prepared to take the first step but the State Department seems rather reluctant at this point.

Mr. LANTOS. Dr. Kelleher.

Ms. KELLEHER. I think here, too, that there is a great deal that could be done by simply stimulating American practices, both as examples and as first steps to encourage Russians to understand that this is going to be a reciprocal arrangement.

DOE ACCOUNTING OF FISSILE MATERIALS

Specifically, for example, we really do not have yet from the Department of Energy a satisfactory accounting of all of the fissile materials that have been produced, the stocks that are available, those that are currently in weapons use, those that are held in reserve, those that might exist in other forms within the nuclear weapons complex.

It seems to me that from what I understand that Secretary O'Leary in fact intended to make such a discussion in December but was dissuaded because of differences of opinion in the interagency process from doing so. It seems to me that this is a positively obvious first step to take. If the Congress were to ask for

such a report, for such an accounting, I am sure that it would be done.

On the civilian side, it is very difficult because we have no guaranteed way of accounting, to in fact identify even the number of metric tons of civilian produced stocks in this country, let alone elsewhere, that one should begin to worry about.

And I think that getting this kind of a baseline, establishing the materials and accounting regimes in this country which we want to see implemented by Russia and eventually worldwide is a very important and fairly, as I say, simple first step that could in fact happen, I think, within a matter of several years at most, perhaps even just one.

Mr. LANTOS. Dr. Chow.

Mr. CHOW. I think on the civilian side, we are really facing a dilemma. On one hand, we must deal with it, because just dealing with materials from the weapons, as you mentioned many times, is not sufficient. On the other hand, dealing with civilian weapon-usable materials is a very difficult one.

What I think is important is that we should now think along the line of carrots. We should look at major issues such as energy security and the problem that countries and also countries have different assessments about when plutonium use may be economical.

ALTERNATIVE TO PLUTONIUM

We must offer an alternative to plutonium and DOE should certainly be one of the agencies in developing those promising alternatives. Also, we must develop institutional arrangements to allow countries to share the plutonium benefits, if any.

My recommendation is that the Congress can stimulate the administration in putting more focus on carrots in its nonproliferation policy, as opposed to sticks.

Mr. LANTOS. Yes, Mr. Leventhal.

Mr. LEVENTHAL. I have had a chance to reflect a bit further in terms of possible legislation. Something that Mr. Einhorn said struck me as perhaps it could be the basis of legislation.

He said the policy of the U.S. Government was to discourage separation of plutonium in excess of near-term needs and so he raised the needs criterion, which there is now no place in U.S. law for, either in the Atomic Energy Act or the Nonproliferation Act.

But Congress might wish to state that it regards need as the determining factor and that that goes right to the heart of U.S. common defense and security interests, such that the United States would not approve of any further separation of plutonium that is not essential to meet near-term needs or where there is already in existence a stockpile of separated civilian plutonium that could be used if utilities really wanted it. And that applies in the case of Britain.

Great Britain today has a surplus of about 30 to 40 tons of civilian plutonium that it cannot make use of for its own reactors, that it will not offer to Japan because it wants to reprocess Japan's fuel and make money off of that, but we have a security interest here and that is to try to keep to a minimum excess plutonium. And I think Congress defining what that means and giving common de-

fense and security value to the need issue could be very useful. At least it would stimulate a debate with the administration.

Mr. LANTOS. I appreciate this.

May I thank all three of you for your extremely valuable testimonies, both oral and prepared. And as a final comment, may I note the relative importance we place on issues such as the nuances of Whitewater followed by 100 million people while we have a smaller audience dealing with an infinitely more significant matter. You have made a very great contribution to our understanding.

I want to thank all three of you.

This hearing is adjourned.

[Whereupon, at 2:57 p.m., the subcommittee was adjourned.]

APPENDIX

TESTIMONY

OF

ROBERT J. EINHORN

DEPUTY ASSISTANT SECRETARY FOR NON-PROLIFERATION
BUREAU OF POLITICAL-MILITARY AFFAIRS
DEPARTMENT OF STATE

March 23, 1994

SUBCOMMITTEE ON INTERNATIONAL SECURITY,

INTERNATIONAL ORGANIZATION AND HUMAN RIGHTS

COMMITTEE ON FOREIGN AFFAIRS

HOUSE OF REPRESENTATIVES

80-838 O - 94 - 2

Mr. Chairman,

Thank you for the opportunity of appearing before your committee to testify on the important issue of controlling and limiting the accumulation of weapon-usable nuclear materials. The Clinton Administration has assigned the nonproliferation of weapons of mass destruction a high priority on its foreign policy and national security agenda and has made it an integral element of U.S. relations with other countries.

A key element of our nonproliferation policy is a recognition that the accumulation worldwide of high enriched uranium and plutonium -- including large quantities of such materials emerging from the disarmament process as well as in the civil nuclear fuel cycle -- present serious challenges that must be addressed. In his September 27, 1993 statement on nonproliferation, President Clinton outlined a comprehensive approach to the growing stocks of fissile material This approach consists of a number of initiatives.

-- a multilateral treaty prohibiting the production of highly-enriched uranium or plutonium for nuclear explosives purposes or outside of international safeguards;

-- the submission of U.S. fissile material no longer needed for our deterrent to inspection by the International Atomic Energy Agency;

-- purchase of highly-enriched uranium from the former Soviet Union and other countries and its conversion to peaceful use as reactor fuel;

-- exploration of means to limit the stockpiling of plutonium from civil nuclear programs to ensure that existing material is subject to the highest standards of safety, security and international accountability, and to minimize the civil use of highly-enriched uranium; and

-- a comprehensive review of long-term options for plutonium disposition, taking into account technical, nonproliferation, environmental, budgetary and economic considerations.

In addition, President Clinton made clear that the United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan.

Let me address each of these initiatives in some detail.

Treaty on Fissile Material Production Cutoff

In his nonproliferation statement of September 27, 1993, and in a speech to the United Nations General Assembly that same day, President Clinton called for an international treaty prohibiting the production of highly enriched uranium and separation of plutonium for nuclear explosives or outside international safeguards.

In October 1993, the United Nations General Assembly adopted by consensus a resolution to negotiate a treaty on the prohibition of the production of fissile material for nuclear weapons or other nuclear explosive devices. This resolution, inter alia,

-- expresses the conviction of the international community that a nondiscriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices would be a significant contribution to nuclear nonproliferation in all its respects;

-- recommends the negotiation of such a treaty in the most appropriate international forum;

-- requests the IAEA to provide assistance for examination of verification arrangements for such a treaty as required; and

-- calls upon all states to demonstrate their commitment to the objectives of such a treaty.

The purpose of the cutoff treaty is to stop further production of fissile materials available for nuclear weapons programs anywhere in the world -- whether in the five avowed nuclear weapon states or the so-called "threshold states" that possess unsafeguarded reprocessing or enrichment facilities and have not joined the NPT. By capping stocks of these materials -- and doing so for nuclear and non-nuclear states alike -- the treaty will make an important contribution to international nuclear nonproliferation norms.

The Administration believes the main undertakings of such a treaty should be commitments to:

-- refrain from producing fissile materials for nuclear explosive devices;

-- refrain from assisting other states to produce fissile materials for proscribed purposes; and

-- accept IAEA safeguards to verify the undertaking not to produce fissile materials for purposes proscribed by the treaty.

The Administration believes that the treaty should be open to universal membership and should be non-discriminatory in its provisions. While it will cap unsafeguarded fissile material production, we do not envisage the treaty as prohibiting the production of HEU or the separation of plutonium for civil nuclear activities under safeguards, or for non-explosive defense purposes such as naval nuclear propulsion. Nor do we see the treaty as a way of obtaining fullscope safeguards -- for example, by placing existing stocks under safeguards. Nonetheless, our goal remains universal NPT adherence and acceptance of full-scope safeguards by all non-nuclear weapon states, and we see a cutoff treaty as a valuable and realistic near-term step toward that goal.

It is particularly important that the ban on HEU production and plutonium separation for nuclear explosives be credibly verified. The United States sees the IAEA as the appropriate agency to carry out this role. The verification measures themselves should be nondiscriminatory and applied in a similar manner in all states party to the treaty.

We are engaged in intensive, informal discussions with other states in order to identify the key issues and elements of the proposed cutoff treaty. The Conference on Disarmament has appointed a special coordinator to explore a negotiating mandate. We hope to see this achieved soon. The U.S. is proposing that the IAEA Director General be asked to convene a group of government experts to examine the verification aspects of the treaty as soon as possible. We are hopeful that significant progress will be made on the cutoff treaty well before the NPT conference begins next spring.

Submitting Excess Fissile Material from U.S. Weapons to Safeguards

The United States has also taken steps that will over time lead to the submission of all U.S. fissile material no longer needed for U.S. defense purposes to inspection by the IAEA. As a nuclear weapon state party to the Treaty on the Non-proliferation of Nuclear Weapons, the United States is not obligated to place its nuclear activities under IAEA safeguards. However, in 1980 the United States concluded a safeguards agreement with the IAEA which makes eligible for safeguards all source and special fissionable materials in all its nuclear facilities except those facilities associated with activities of direct national security significance. The IAEA has previously selected for safeguarding one to three of the some 230 nuclear facilities that the United States has made eligible for inspections, although resource constraints have in recent years prevented the Agency from actually applying safeguards in the U.S. The U.S. is currently reviewing its list of eligible facilities to ensure that it is up to date.

We intend eventually to submit all fissile material no longer needed for the U.S. defense programs to inspection by the IAEA. Some initial decisions have already been made on what nuclear materials are excess and therefore will be eligible for safeguards. However, this will be a continuing process, and it is impossible to predict at this stage how long it will take before all excess nuclear material is placed under IAEA inspection.

A number of steps will need to be taken. Nuclear materia excess to defense requirements are located in a variety of facilities, some of which are associated with activities of direct national security significance. Excess materials may need to be segregated from nuclear materials remaining in the strategic reserve in order to permit IAEA inspection. These materials are in a variety of different forms, including residues, spent fuel, HEU in metal form and plutonium-239 in oxide and metallic forms. Much of it will be in the form of nuclear weapons components.

The U.S. is proceeding in a step-by-step fashion. Our present plans are initially to place under safeguards several tonnes of former defense materials that are in nonsensitive forms of HEU. This material will be stored in a vault in Oak Ridge, Tennessee. We hope to submit the required notification to Congress sometime this spring. The notification must lie before Congress for 60 calendar days before it may take effect. The IAEA should have conducted its initial verification of this material by September.

We are also planning to submit to safeguards several tonnes of plutonium in nonsensitive, oxide and metallic form located in Hanford, Washington and/or Rocky Flats, Colorado. We hope that IAEA inspections on this excess plutonium could begin by the end of 1994.

Submitting nuclear weapon components to IAEA safeguards will pose particularly challenging inspections issues. The U.S. and the IAEA must devise an inspection approach which will provide the IAEA with the opportunity for credible verification of the nuclear material concerned while at the same time protecting sensitive nuclear weapons design information.

The U.S. is conducting two major reviews to address the issue of component inspection. In the first study, we are examining potential alternatives to classical IAEA safeguards procedures and practices. Such approaches include verification of non-sensitive characteristics of weapons components, or confirmation of sensitive information without such information being revealed to inspectors. At the same time, a study is underway to examine whether declassification of certain information about nuclear weapons components would involve unacceptable proliferation or national security risks.

The results of these studies will be closely coordinated. The U.S. intends to work closely with the IAEA in assessing the inspection options and in designing procedures which will provide a high degree of assurance to the international community that material removed from nuclear weapons will not be returned to such use.

In addition to this unilateral step, President Clinton and President Yeltsin issued a joint summit statement on nonproliferation on January 14, 1994, in which, they agreed to consider

> including in their voluntary safeguards offers all source and special fissionable materials excluding only those associated with activities having direct national security significance, (and)
>
> steps to ensure the transparency and irreversibility of the process of reduction of nuclear weapons, including the possibility of putting a portion of fissionable material under IAEA safeguards. Particular attention would be given to materials released in the process of nuclear disarmament and steps to ensure that these materials would not be used again for nuclear weapons.

We hope that the Russian Federation will be able to join us in placing materials no longer needed for its defense under safeguards, and in broadening the scope of its voluntary safeguards offer so that it covers all Russia's civil facilities. U.S. and Russian steps in this direction will make a significant contribution to arms control, nonproliferation and international and regional peace and security.

In furtherance of the agreement between Presidents Clinton and Yeltsin, on March 16 Secretary of Energy O'Leary and Russian Minister of Atomic Energy Mikhailov announced in a joint statement their intention to host reciprocal inspections by the end of 1994 to facilities containing plutonium removed from nuclear weapons. We see this as a first step towards meeting the commitments made by the two Presidents and toward achieving greater control and accountability over stocks of fissile materials worldwide, even in nuclear weapon states.

I would also note, in this context, that the U.S. has signed agreements with Russia as well as Ukraine and Kazakhstan to strengthen the material control and accountancy and physical protection systems in these countries. These steps will be critical not only to prevent theft or diversion but will also facilitate the application of IAEA safeguards.

Plutonium-239

There are already large global stocks of plutonium from civil nuclear programs excess to foreseeable needs. The U.S.

believes that the growing quantities of separated plutonium have the potential to raise concerns for the nonproliferation regime. In states where material control and accountancy or physical protection systems are not sufficiently rigorous, there is a risk of diversion or theft of such materials. In addition, even in states with effective nonproliferation commitments and physical controls, the presence of stocks of plutonium that have no legitimate near-term civil use could be perceived as threatening by neighboring states. Accordingly, U.S. policy is not to encourage the civil use of plutonium. The United States does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes, and we are urging other nations with programs for the civil use of plutonium to limit the stockpiling of such plutonium. In this connection, it is important to note that the joint statement of President Clinton and President Yelstin registered the agreement of our two countries to cooperate with each other and also with other states to elaborate measures designed to prevent the accumulation of excess stocks of fissile materials and over time to reduce such stocks.

The United States has ceased the production and separation of plutonium for nuclear explosives. The Russian Federation has shut down all but three of its plutonium production reactors. The Russians have not closed these reactors, two at Tomsk and one at Krasnoyarsk, because these reactors supply needed electricity and district heating to the local population. According to the Russians, the spent fuel from these reactors continues to be reprocessed for two reasons: first, the spent fuel rods have aluminum cladding and will corrode to an unacceptable degree within two to three years. second, there is insufficient storage capacity for more than one year of spent fuel production. Hence, weapons-grade plutonium continues to be separated at these two sites. The Russians have indicated their willingness to shut down the three production reactors as soon as alternative energy and heat sources become available. The U.S. has expressed its willingness to help the Russians accelerate the shutdown process. Toward this end Vice President Gore and Prime Minister Chernomyrdin agreed in December 1993 to conduct a joint study of the possibilities of terminating the production of weapon-grade plutonium as soon as possible. At their summit meeting President Clinton and President Yeltsin reaffirmed their commitment to complete this study within a short time. In the last few weeks we have met with the Russians in Washington and agreed to terms of reference for this study. We will be looking in particular at the feasibility and costs of nonnuclear alternatives to the Tomsk and Krasnoyarsk reactors and hope to complete the joint analysis within the coming months. In addition, the U.S. and Russia have agreed to negotiate an agreement to cease the military use of plutonium separated after the date of the agreement. This agreement will allow for inspection of each side's relevant plutonium production facilities as well as the storage sites for plutonium produced from the reactors at Tomsk and Krasnoyarsk.

We are also engaged in consultations with several countries which have major reprocessing and plutonium use programs in order to explore ways of increasing transparency of plutonium stocks and flows and to develop guidelines on plutonium storage and use, including international storage and management options which would be supplemental to IAEA safeguards. In these discussions, the U.S. stresses the importance of balancing the supply and demand of separated plutonium in order to avoid the accumulation of unneeded stockpiles of this material and the need to agree to effective measures to limit and ultimately reduce and eliminate excess separated plutonium.

However, the United States is also committed to being a reliable nuclear trading partner and to avoiding confrontation with close friends and allies whose cooperation with us is critical to achieving important nonproliferation goals, such as a comprehensive test ban and a fissile cutoff. Therefore, for Western Europe and Japan, where there are large, well established civil reprocessing and plutonium facilities and comprehensive nonproliferation commitments, the U.S. will continue to grant prior consent on a predictable and long-term basis for reprocessing of spent fuel and civil use.

At the same time the U.S. is actively discouraging reprocessing in areas of instability and high proliferation risk. For example, a key U.S. objective in resolving the North Korean nuclear issue is full implementation of the ROK-DPRK Joint Declaration on Denuclearization of 1991, in which the North and South agreed to ban reprocessing and enrichment facilities on the Peninsula.

Plutonium Disposition

The U.S. is also initiating a comprehensive review of long-term options for the disposition of plutonium. We have established an interagency group to conduct this review and it will take full advantage of the excellent work already done by the National Academy of Science, the Office of Technology Assessment and other studies. In addition, in their joint summit statement of January 14, 1994, President Clinton and President Yelstin agreed to task their experts to study options for the long-term disposition of fissile materials, particularly plutonium. We will be soon discussing with the Russians an appropriate mechanism for implementing this study.

High Enriched Uranium

Neither the U.S. nor Russia produces HEU for nuclear weapons. However, significant quantities of HEU are emerging from the dismantlement of nuclear weapons, and the United States has taken steps to reduce the proliferation risks associated with this material. The U.S. has concluded an agreement with the Government of Russia to purchase up to 500 hundred tonnes of HEU from dismantled nuclear weapons. This

material will be blended down to low enriched uranium (LEU)--a non-weapons usable material--for use in peaceful nuclear programs. Unlike plutonium, HEU can be diluted to a non-weapons form and the resulting LEU sold on the international market as an economic fuel for nuclear power reactors. The U.S. and Russia have also agreed to transparency measures to provide confidence to both parties that the HEU comes from dismantled nuclear weapons, not new production, and that the blended-down material will be used for peaceful purposes.

An important U.S. nonproliferation objective has been to minimize the use of high enriched uranium (HEU) in civil nuclear programs. Unlike plutonium, HEU is largely confined to research uses and there are no large stockpiles of this material in commercial use. The research and test reactors around the globe which use HEU as a fuel can for the most part be converted to use LEU fuel and this has been a key objective of U.S. nonproliferation policy for many years.

In 1978, the United States established the Reduced Enrichment for Research and Test Reactor (RERTR) program to reduce the amount of HEU available in international commerce. The RERTR program is aimed at reducing the demand for HEU by developing research reactor fuels using LEU to replace the HEU in both domestic and foreign research reactors.

The RERTR program has helped to bring about the conversion of a significant number of foreign reactors from the use of HEU and has contributed to the reduction in the level of exports of HEU by the United States. Eighteen foreign governments with 41 reactors currently participate in the program and are involved in extensive technical cooperation with Argonne National Laboratory (ANL) for conversion of their research reactors to the new LEU fuels. Of the 42 U.S.-fueled foreign reactors with power levels above 1 megawatt (MW) currently in operation, 38 have determined that it is feasible for them to convert to use of LEU, 34 have developed conversion plans, 25 have begun test irradiation of LEU fuel, 20 have placed orders for LEU fuel, 14 have begun conversion to LEU, and 11 have completed conversion. Only four U.S.-fueled foreign reactors have not initiated conversion steps and three of those are technically unable to use currently available LEU fuels.

Conclusion.

Let me conclude, Mr. Chairman, by reaffirming the strong commitment of this Administration to limiting and eventually reducing global stocks of plutonium and high enriched uranium, including those emerging from the disarmament process, and to ensuring that existing stocks are subject to the highest standards of physical protection and safeguards. The approach which I have outlined in this statement has been carefully tailored to address the specific risks associated with these materials and with our diverse regional security concerns. We believe it will prove to constitute a set of effective measures to manage and reduce the proliferation risks of nuclear weapon-usable materials.

Testimony

of

Norman A. Wulf

Acting Assistant Director

Non-Proliferation and Regional Arms Control Bureau

U.S. Arms Control and Disarmament Agency

Subcommittee on International Security,

International Organizations, and Human Rights

Committee on Foreign Affairs

House of Representatives

March 23, 1994

Mr. Chairman,

Thank you for this opportunity to address the Subcommittee on the Administration's efforts to control and limit weapons-usable fissile material. Nonproliferation of weapons of mass destruction has always been high on ACDA's arms control agenda and President Clinton has placed nonproliferation high on his list of foreign policy and national security priorities.

In his September address to the UN General Assembly, President Clinton established a broad framework for US efforts to prevent proliferation of weapons of mass destruction. A key element of that framework is a comprehensive approach to limit the availability of weapons-usable fissile material -- highly enriched uranium (HEU) and separated plutonium (Pu). Acquiring highly enriched uranium and separated plutonium is a critical hurdle in a nuclear weapons development program and preventing states from acquiring such materials remains a major focus of our nuclear nonproliferation efforts.

President Clinton's approach combines a global ban on producing such material for nuclear explosive devices; reducing and eventually eliminating the accumulation of stockpiles of excess highly enriched uranium and separated plutonium; placing under inspection by the International Atomic Energy Agency (IAEA) US fissile material from dismantled weapons that is no longer needed for our deterrent; and reviewing long-term options for plutonium disposition. ACDA has been working with other agencies to develop and implement the various aspects of this policy.

The United States has taken major unilateral steps -- we no no longer produce HEU or separated Pu for weapons. Moreover, we are placing material from the weapons program no longer required for defense under IAEA safeguards and we are working with Russia on similar steps for their weapons production complex. I would like to focus my remarks today, however, on the multilateral treaty banning the production of high enriched uranium and separated plutonium for nuclear explosives or outside international safeguards. As the lead agency for multilateral arms control negotiations, ACDA will play an important role in negotiating this convention on the cutoff of the production of weapons usable material.

Proposals for a treaty of this type date as far back as 1954 when a proposal for a halt in such production was advanced by Indian Prime Minister Nehru. For the last decade, Canada has introduced resolutions for a cutoff in the UN General Assembly. Last year, pursuant to President Clinton's initiatives, the United States, for the first time, supported such a resolution in the UN. The UN resolution adopted by consensus last fall:

--expresses the conviction of the international community that a nondiscriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices would be a significant contribution to nuclear non-proliferation in all its aspects;
--recommends the negotiation of such a treaty in the most appropriate international forum;
--requests the IAEA to provide assistance for examination of verification arrangements for such a treaty as required; and
--calls upon all states to demonstrate their commitment to the objectives of such a treaty.

Its consensus adoption provides a basis for believing that conclusion of such a treaty is achievable.

By capping worldwide the amount of material available for nuclear weapons in all states, the treaty would place a limit on the number of nuclear weapons that could be developed. In areas like South Asia, achieving such a limit would be an important first step toward the U.S. goal of encouraging a future South Asia free of nuclear weapons and other weapons of mass destruction.

It is important to stress what this proposal would and would not do. It would not require a ban on production of separated plutonium or highly enriched uranium. It would require, however, international safeguards on at least enrichment and reprocessing activities so that the IAEA could verify that any further separation of plutonium or enrichment to high enrichment levels is not for weapons purposes. However, the United States will continue its efforts to prevent the spread of reprocessing and enrichment capabilities.

In preliminary, informal discussions with other states, we have identified key elements and issues for the proposed cutoff treaty. We envision that states would undertake

- not to produce fissile materials for nuclear explosive devices
- not to assist other states in activities proscribed by the treaty, and
- to accept IAEA inspections to verify the undertakings of the treaty

We envision the treaty to be open to universal membership and, as I have said, to be nondiscriminatory in its provisions.

To have a chance of gaining the adherence of such states as India and Pakistan, the proposal must be truly non-discriminatory. Therefore, the proposed cutoff treaty would not require states to eliminate past production of highly

enriched uranium or separated plutonium. Some have criticized the proposal as de facto acceptance of this past production.

Certainly, this is not the Administration's view.

Ever since the Indian detonation of a nuclear device in 1974, it has been the consistent policy of the United States that both India and Pakistan should place all of their nuclear facilities under safeguards and foreswear, in an international legally binding instrument, the acquisition of nuclear explosive devices. The most commonly accepted international legal instrument is the Nuclear Nonproliferation Treaty (NPT) with some 162 parties. Pakistan has asserted that it will become a party to the NPT if India does, but thus far India has continued to reject the NPT as being discriminatory. Therefore, U.S. policy has viewed an internationally verifiable nuclear weapons free zone, similar to the Treaty of Tlatelolco which applies to Latin America, as an acceptable alternative. This long-standing U.S. policy remains the policy of the Clinton Administration.

It is recognized, however, that achieving a nuclear weapon free zone in the sub-continent will be neither easy nor rapid. Meanwhile, the situation continues to deteriorate as both continue to work on nuclear weapons programs and are undertaking preparations to deploy ballistic missiles capable of delivering nuclear warheads. Thus, the Administration views the cut-off proposal as a key step in a multi-step process that is hoped would eventually lead to a South Asia free of nuclear weapons.

Effective verification of the treaty is very important, and the Administration sees the IAEA as the appropriate agency to carry out such verification. We are still exploring the range of verification possibilities. Some of the factors that need to be considered are the need for assurance that material being produced is not weapons usable or that it is not available for use in weapons; the negotiability of the verification arrangements to all the countries that we wish to become parties to the treaty; and the impact of those verification arrangements on the ability of the IAEA to apply safeguards elsewhere.

The US and most states agree that the Conference on Disarmament (CD) is best suited for formal negotiations of a cutoff treaty. In January, the CD appointed a special coordinator for cutoff issues, Amb. Gerald Shannon of Canada. Amb. Shannon must report to the CD at the end of this month on the consultations he has held with member states since January. Among other things, Amb. Shannon will recommend whether it is appropriate to establish an ad hoc committee on cutoff during the CD's second round scheduled to begin in May. If so, this could lay the groundwork for early negotiations. It is not clear how the CD will decide to proceed, given negotiations in progress on the comprehensive test ban, but we

believe it should move promptly. At the same time, we are proposing that verification discussions might go forward in Vienna, where considerable safeguards expertise is available.

In conclusion, the fissile material production cutoff treaty is one among several measures designed to reduce growing stockpiles of weapons-usable material. Its verification procedures, including, at least, safeguards on all enrichment and reprocessing facilities, will take us a step closer to full-scope safeguards for all non-nuclear weapon states. As a multilateral, nondiscriminatory measure, it will help strengthen the global norm of nonproliferation. Progress toward such an agreement would help US efforts to achieve indefinite extension of the NPT in 1995. President Clinton's proposal for the multilateral treaty affirms the Administration's commitment to limiting stockpiles of excess fissile materials.

STATEMENT BY

DR. HAROLD P. SMITH, JR.

ASSISTANT TO THE SECRETARY OF DEFENSE

(ATOMIC ENERGY)

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL SECURITY,
ORGANIZATIONS AND HUMAN RIGHTS

COMMITTEE ON FOREIGN AFFAIRS

HOUSE OF REPRESENTATIVES

SECOND SESSION, 103RD CONGRESS

HEARING ON STEMMING THE PLUTONIUM TIDE: LIMITING THE ACCUMULATION OF WEAPON-USABLE NUCLEAR MATERIAL

MARCH 23, 1994

INTRODUCTION

Mr. Chairman, members of the Committee, I am pleased to have this opportunity to discuss with you our efforts and progress in implementing those aspects of the Cooperative Threat Reduction (CTR)/Nunn-Lugar program that reduce the threat from weapons-useable nuclear materials in the former Soviet Union.

The Administration considers the spread of weapons of mass destruction, and of related nuclear materials and know-how, to be one of the most serious threats to U.S. national security interests in the post-Cold War period. Our execution of the CTR program is one of the pivotal ways by which we are meeting this threat, as well as the other dangers associated with the breakup of the Soviet Union. I believe the Cooperative Threat Reduction program can take great credit, thus far, in reducing the threat to international security from the nuclear material throughout the life cycle of nuclear weapons in the former Soviet Union (FSU).

During our session today, I will describe our progress in implementing the CTR program, and the way ahead toward fulfilling the vital objectives established by Congress in 1991, and reaffirmed since by Congress and this Administration..

BACKGROUND

I believe it is important for us to remain mindful of the events and conditions that led to the initiation of the CTR program two and a half years ago, because these conditions largely still exist today, and the clock is still ticking. Congress determined in late 1991 that the following types of danger to nuclear security and stability existed in the rapidly disintegrating Soviet Union and that the Soviet successor states with nuclear weapons located on their territory -- Russia, Belarus, Kazakhstan, and Ukraine -- would require assistance to address them: (1) ultimate disposition of nuclear weapons in a manner that would not be favorable for nuclear weapons safety or international stability; (2) the possibility of seizure, theft, sale, or use of nuclear weapons or components; and (3) transfer of weapons, weapon components, or weapon know-how, contributing to proliferation outside of the territory of the former Soviet Union.

In light of these identified risks, Congress established a set of objectives that continue to guide the program today. These objectives affirm the U.S. intention to provide assistance to the new independent states of the former Soviet Union for implementing and facilitating: (1) the destruction of nuclear, chemical, and other weapons of mass destruction (WMD); (2) the safe and secure transport, storage, and safeguarding of such weapons in connection with their destruction; and (3) the prevention of proliferation of weapons, materials, technology, and WMD know-how from the former Soviet Union.

Fulfillment of these objectives within the CTR program, in turn, has become essential to other efforts critical to U.S. national interests. These include the Russian ability to meet START

and CWC reduction schedules; the complete denuclearization of Belarus, Ukraine, and Kazakhstan and these countries' corresponding ability to meet their START and Nuclear Non-Proliferation Treaty (NPT) obligations; and efforts (such as defense conversion and expanded defense-and-military contacts) that will have profound, lasting, positive effects on the infrastructures in the recipient countries toward the building of democracies and market economies. The Administration is committed to meeting all of these objectives and programs, and has given CTR the highest-level attention and interest

The program consists of projects that have resulted from negotiations and agreements between the United States and the four recipient countries. These projects have been notified to and approved by Congress, and address the following thrust areas: strategic offensive arms elimination in Russia, Belarus, Ukraine, and Kazakhstan; safety and security of nuclear weapons during the elimination process; chemical demilitarization in Russia; defense conversion; nonproliferation; and critically important CTR support efforts that do not fall neatly into the above categories, but that are absolutely necessary for the program to function effectively. It has taken about two years for the mutual trust between the U.S. and our former adversaries in the new independent states of the former Soviet Union to mature to the point where it is now, based on an ongoing record of demonstrated sincerity and genuine progress. As recently as just a few months ago, there were 18 CTR projects underway with Russia and Belarus; today there are over 30 involving all four recipient states. The CTR program has also become an integral part of our arms control and counterproliferation objectives and initiatives, as well of even broader interests, in serving our national security.

To date, $400 million has been authorized for the CTR program in each of the Fiscal Years 1992, 1993, and 1994. Of that amount, Congress has been notified of our intent to spend $961 million in support of a wide range of CTR projects in the four recipient states. We have concluded 31 agreements that commit $761 million. To date we have obligated over $113 million, we intend to obligate approximately $400 million by the end of Fiscal Year 1994, and have plans to obligate an additional $400 million in Fiscal Year 1995.

IMPLEMENTATION & EXECUTION

Our implementation of the Cooperative Threat Reduction program is guided by detailed planning, with a clear vision of CTR's direction in currently programmed areas, and with a desired end point. In particular, our planning looks ahead to a successful end to the program, when the requisite weapons dismantlement and safe storage objectives will have been met completely by the end of this century. Assistance for monitoring and safeguarding the remaining nuclear materials in Russia may require continuing support beyond that time frame, but at a relatively modest cost with a hugely effective return in terms of our national security.

SAFETY AND SECURITY OF NUCLEAR WEAPONS DURING THE DISMANTLEMENT PROCESS

Questions continue to be asked about how we know that Russian nuclear warheads are being dismantled and how we can be sure that the fissile materials from dismantled weapons are not being recycled into new weapons. The Russian Federation does not need and has not requested direct assistance in the actual dismantlement and destruction of nuclear warheads. Nonetheless, the ongoing CTR projects in both the strategic offensive arms elimination and the nuclear warhead safety and security areas, when considered together in a complementary and coherent program as we are doing, have a distinct effect in reducing the threat tantamount to direct involvement in or monitoring of dismantlement. We are undertaking projects and an integrated approach that enable us to make assessments about the progress of the program in real-world terms of threat reduction.

Since the CTR program is cooperative in nature and not an arms control regime per se, monitoring in this program, as mandated by Congress, emphasizes the transparency of the program's implementation rather than verification in the traditional, sometimes adversarial sense common to the classical arms control framework. In addition to satisfying the U.S. public and Congressional audiences, the program's implementation should also satisfy the requirement of the FSU states, other countries in the region, and world opinion in general.

Nearly every CTR project can be related conceptually to a specific stage or node in a complete weapons chain of custody from initial inventory control and secure storage to transport, interim storage, dismantlement, and final disposition; however, it would probably be impractical and very difficult for the U.S. to insist on transparency of the complete chain of custody. A program that covers a portion of the chain of custody can still provide increased assurance that CTR objectives and mandates are being met. By engaging such transparency measures at a late stage in the chain of custody, such as during the storage of nuclear components and materials from dismantled weapons, important knowledge about the weapons dismantlement process can be obtained.

The CTR program has had tangible results in reducing the threats to U.S. security emanating from the breakup of the Soviet Union. In the immediate wake of the Nunn-Lugar legislation, officials of the Commonwealth of Independent States gained confidence as a result of the newly emergent U.S. cooperative assistance program to return nuclear weapons and materials to Russia for dismantlement or storage. It is apparent that CTR gave them this confidence by offering the promise, now being delivered, of equipment and training enabling them to deal safely and securely with the significantly increased warhead transportation and storage demands. Our efforts under CTR in ensuring the safety and security of nuclear weapons transport and storage in Russia add further to the threat reduction picture.

The first contribution of the CTR program toward reducing the threat from FSU nuclear weapons and materials was directed toward the safe and secure transport of nuclear warheads

from the field to the dismantlement plant and of weapon components and materials to the storage facility In response to a request from the Russian Federation, the United States supplied armored blankets to protect weapons and components in transport and storage from small arms fire and grenade fragments Within a month of signing an implementing agreement in June 1992, the United States provided 1500 sets of used armored blankets. We then procured 2520 new blankets and delivered them in June 1993 at a cost of $3.3 million.

We are executing emergency response equipment and training agreements with all four recipient countries to deal with assessing and mitigating the effects of an accident involving nuclear weapons being transported for dismantlement. Since signing emergency response agreements with Russia and Belarus in June and October 1992, respectively, we have provided over 1300 items to Russia and nearly 700 items to Belarus including protective clothing, radiation detection equipment, and communication gear. We are working with Ukraine and Kazakhstan to complete the definition of their emergency response requirements.

We are also executing an agreement signed in August, 1992 to significantly upgrade the safety and security of Russian nuclear warhead transport rail cars by providing modification kits for fire protection, thermal protection, and increased capability to detect unauthorized intrusion. The project began with the shipment of a Russian rail car to the U.S. in December, 1992. A prototype rail car and four conversion kits were shipped back to Russia in November. 1993 followed by a demonstration and training session in Russia by U.S. technical experts on the rail car conversion process. This project is on schedule, and delivery of kits for 100 cargo rail cars and 15 guard rail cars will be completed by October of this year at a total cost of no more than $21.5 million.

One key bottleneck to timely progress in warhead dismantlement, identified in early conversations with Russian officials, has been the lack of containers for safely transporting and storing fissile materials removed from dismantled warheads. We agreed to provide up to $50 million for at least 10,000 fissile material storage containers with a non-binding delivery scheduled by December 31, 1995. The containers that we developed are a modification of a Russian design. Aggressive program execution has allowed us to deliver an increased number of containers well ahead of schedule. The current contract calls for nearly 33,000 fissile material containers with initial deliveries in July, 1994, and continuing through early 1997. Prototype containers have been manufactured in the United States and shipped to Russia, and in a few months we will begin shipment of production versions of the containers.

Components from dismantled nuclear weapons in the containers will be placed in a modern fissile material facility dedicated and specifically designed to ensure safe and secure storage of fissile material. This facility has also been identified by Russian officials as a significant bottleneck to process on nuclear warhead dismantlement. Immediately after signing an implementing agreement in October, 1992, DoD began to provide technical assistance to the lead Russian design agency. This $15 million effort is nearly complete. Our design support package has been delivered to the Russians, who intend to start construction in July 1994. DoD assistance

in the design will continue through July as we update the safety analysis and provide additional technical reviews of the final Russian design.

We are working toward establishing a cooperative transparency regime for the storage facility Our objectives for this transparency regime include achieving confidence that: the material stored in the facility is safe from unauthorized use, theft, or diversion; the fissile material is from dismantled nuclear weapons; and any U S. assistance for the facility is used for its intended purpose All of these objectives are derived from the Nunn-Lugar legislation that authorizes U.S assistance. Russia has indicated that it too is committed to these goals.

In order to ensure that the fissile material storage facility becomes operational at the earliest possible date, DoD agreed in September, 1993, to provide up to $75 million in equipment for the facility. This equipment falls into three broad categories: construction; generalized facility equipment (i.e., heating, power generation and distribution, and physical security); and specialized facility equipment (i.e., material control and accounting, specialized sensors, and blast doors). To date, none of the funds set aside for equipment have been obligated or expended.

A major obstacle to executing this agreement has recently been removed. The continued production and chemical separation of weapons grade plutonium in the reactors at Tomsk and Krasnoyarsk led the Congress to adopt the Markey Amendment to the FY 1994 Defense Authorization Act that stated that no funds could be obligated or expended by the US for the purpose of assisting the Ministry of the Russian Federation for Atomic Energy (MINATOM) to construct the storage facility until the President certified to Congress that Russia is committed to halt the chemical separation of weapons grade plutonium and is taking all practical steps to halt such separation at the earliest possible date. Progress toward meeting this requirement was made at a December, 1993 meeting of the Commission led by Vice President Gore and Russian Prime Minister Chernomyrdin, during which it was agreed that the Government of Russia would work with the U S. to develop a timeline for closing Russia's remaining three plutonium production reactors Commitment to proceed along this path was restated by Presidents Clinton and Yeltsin at their January, 1994 Summit meeting. Secretary of Energy O'Leary and MINATOM Minister Viktor Mikhailov announced on March 16, 1994 agreement to undertake a joint study of alternative power sources that would enable the plutonium production reactors to be phased out. Secretary of State Christopher signed the certification on March 17, 1994 that the Russian Federation has made the commitment required by the Markey Amendment, and this should be received shortly by the Congress.

Ambassador James Goodby is leading a US delegation in Moscow this week to discuss other outstanding issues related to the storage facility. Once this has occurred, the Defense Nuclear Agency, our program manager for CTR, is poised to promptly provide construction equipment and commence the design and procurement process for the necessary general and specialized facility equipment.

When the fissile material containers and storage projects are taken together, they comprise efforts to remove and account for a major portion of the weapons-useable materials removed from warheads dismantled in Russia. Although we are not assisting in direct warhead dismantlement, we are providing the assistance that enables dismantlement to proceed more quickly than it would otherwise, and gives us a means of accounting for this progress.

The CTR program is also promoting U.S. nonproliferation objectives through establishment of science and technology centers in Moscow and Kiev to employ Russian and Ukrainian weapon scientists in productive civilian endeavors. These will help prevent a potential brain drain from contributing to the global proliferation problem and, at the same time, is an investment in a demilitarized future for former Soviet science.

The International Science and Technology Center (ISTC), headquartered in Moscow, began operations on March 3, 1994. This followed the signing of a protocol by the founding parties, the United States, the European Union, Japan and the Russian Federation on December 27, 1993, that allowed the Center to open on a provisional basis pending ratification by the new Russian parliament. The U.S. has provided $25M to the ISTC through the CTR program, The European Union has provided $25 million, Japan has provided $17 million, and the Russian Federation has provided the headquarters facility. The objective of the ISTC is to prevent the proliferation of technology and expertise related to WMD by providing peaceful employment opportunities to scientists and engineer formerly involved with WMD including their delivery systems. The ISTC Governing Board approved the first round of funding for ISTC projects during its inaugural meeting on March 17-18, 1994 in Moscow. A total of $11.9 million was committed to 23 projects involving more than 600 Russian scientists and engineers as well as hundreds of additional technical support personnel. The governing board also acted favorably on requests for membership in the ISTC from Armenia, Belarus, Canada, Finland, Georgia, Kazakhstan and Sweden.

Secretary of State Christopher and representatives from Canada, Sweden, and Ukraine signed an agreement to establish a Science and Technology Center in Ukraine (STCU) on October 25, 1993. The U.S. has pledged $10M to the STCU through the CTR program, Canada has pledged $2 million, and Sweden has pledged $1.5 million. The Ukrainian government has indicated that they are now prepared to take executive action to complete the internal procedures required for the STCU agreement to enter into force, and we eagerly await word from Ukraine that these internal procedures have been completed. In the meantime, the Department of State is consulting with our partners, and we are prepared to move things forward quickly over the coming months to get the STCU up and running.

The CTR program is also to reducing the risk from nuclear materials in the civilian fuel cycle by providing assistance to Russia, Belarus, Ukraine and Kazakhstan in export control and in nuclear material control, accountability (MC&A) and physical protection.

The United States and Russia signed an agreement in September, 1993 under which $10 million of CTR assistance will be provided to augment the MC&A and physical protection of nuclear material used in peaceful nuclear activities, nuclear power/research reactors, and fuel cycle facilities. In December, 1993, agreements were concluded and signed with Kazakhstan for $5 million and with Ukraine for $7.5 million and to facilitate the development of state systems for MC&A and physical protection of peaceful nuclear material.

A need remains for governmental controls that effectively restrict exports of nuclear materials and other items that might aid other states in the development of weapons of mass destruction. We concluded an agreement with Belarus in October, 1992 to provide $1 million of CTR assistance to assist in establishing the building of export control institution and infrastructure. The assistance under this agreement, which has now been increased to over $16 million, includes provision of radiation detection equipment to reduce proliferation risk through preventing transshipment of nuclear materials. CTR agreements were signed with Ukraine and Kazakhstan to provide each state $2.3 million of assistance in establishing an export control system, and technical experts are working with each country to establish their requirements prior to provision of goods and services under these agreements.

The Way Ahead

The programs described above are integrated in purpose and contribute to measurably improving the safety and security of nuclear warheads and materials. As initial investments focused toward preventing the loss of plutonium and HEU, they have been sound. But, our future efforts require a more visionary approach. Let me explain where I see that additional assistance may be required and where I would like us, in cooperation with the Russians, to work toward reducing the threat from nuclear materials from dismantled warheads.

We are prepared to offer the Russian Federation assistance in instituting measures for non-intrusive monitoring of the chain of custody of nuclear warheads and the fissile materials removed from them. This will permit even more confident assessments of the progress of safe and secure dismantlement. Measures of this type will not only ameliorate our concerns but will also enable the Russians to have better accounting and physical security over the weapons and materials. In light of the political and social turmoil and instabilities in Russia, this will benefit not only them but us as well.

As an important step forward, officials of key U.S. Government agencies had preliminary discussions with Minister Mikhailov during the week of March 14, 1994, about mutual inspection of facilities containing fissile material from dismantled weapons. On March 16, 1994, DOE and MINATOM announced their intention to host mutual inspections by the end of the year of facilities containing plutonium removed from nuclear weapons. The United States Government is considering ways to carry out these inspections. One approach would be to use technology

developed in the U.S. by DOE and/or in Russia by MINATOM to make measurements on containers containing Pu pits in the United States and Russia. By using this technology to confirm the presence and amount of Pu in sealed containers without divulging nuclear weapons design information, each side would gain increased confidence that nuclear weapons are indeed being dismantled and that a reliable inventory of the resulting material can be accomplished in a non-intrusive fashion. Technical experts will meet by May 16, 1994 to define the procedures for these inspections.

The Clinton Administration has taken an unprecedented step in determining unilaterally that U.S. fissile materials no longer needed for our deterrent will be brought under the monitoring program of the International Atomic Energy Agency. This, we hope, provides an incentive for the Russian Federation to do likewise in enhancing the transparency of its nuclear materials cycle and of its weapons dismantlement efforts. We have developed concepts for monitoring and auditing the warhead dismantlement and fissile materials disposition processes without revealing sensitive warhead design features, and we will continue to press for Russia's acceptance and implementation of such measures.

Recent Gore-Chernomyrdin Commission and January 1994 Moscow Summit initiatives have called for expanded United States-Russia cooperation in the area of MC&A and extending MC&A to military facilities. We have notified Congress of our intent to obligate up to $20 million under an agreement to expand the United States-Russia cooperation on the development of Russian control, accounting, and physical protection of nuclear material to prevent the proliferation from Russia of nuclear weapons and fissile material. The additional CTR assistance would provide for the extension of MC&A systems to at least one military facility in Russia, such as the blending facility for highly enriched uranium (HEU) at Ekaterinburg. Installation of a comprehensive MC&A system at such a facility could support the establishment of transparency arrangements under the agreement between the U.S. and Russia for the U.S. to purchase HEU derived from dismantled Russian nuclear warheads. Funds proposed to be obligated may also be used for an MC&A survey of Russian facilities, to be followed by the implementation of high priority improvements to prevent the proliferation of nuclear materials. This assistance could also be used to establish a model MC&A system at a bulk handling facility where large inventories of plutonium are located.

We have received a request from the Russian Federation to increase the total number of fissile material storage containers provided to 100,000. In addition, we have been asked for financial support of construction of the fissile material storage facility. These requests are currently under consideration by the U.S. Government.

CONCLUSION

The CTR program has made tremendous strides and is a key element of U.S. efforts in reducing the threats that attended the breakup of the Soviet Union and the breakdown of

economic, social, and political stability in the successor states. The program is clearly meeting the objectives established by Congress in 1991 and reaffirmed repeatedly since then by Congress and this Administration. One of the most important achievements of the CTR program has been the reduction of the threat from weapons-useable nuclear materials in the former Soviet Union.

This Administration is committed to completing the Cooperative Threat Reduction program and to achieving the farther-reaching national security goals whose fulfillment depends on continuation of the program. As I have indicated, our planning is done with a clear vision of how the various projects fit together to fulfill the program's objectives and of how we will disengage when the objectives have been met at the end of this century. When CTR is viewed as a whole, its impact on reducing warheads, delivery systems, proliferation risks, and even future risks and threats is clearly evident. By completing the elements of the program related to reduction of threat from weapons-useable nuclear material that I have described today, we will have even greater assurance that nuclear weapons are being dismantled and that the resulting nuclear components and materials are under safe, secure storage.

Thank you for giving me this opportunity today to discuss Cooperative Threat Reduction with you, and I will be happy to answer your questions.

Statement of

Robert W. DeGrasse, Jr.

Director, Surplus Fissile Materials Control & Disposition Project

U.S. Department of Energy

before the

Subcommittee on International Security,

International Organizations and Human Rights

Committee on Foreign Affairs

U.S. House of Representatives

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INTRODUCTION

Mr. Chairman and members of the Subcommittee, I am pleased to appear before you today to discuss the risk to international security posed by the rapid accumulation of plutonium, and the Department of Energy's efforts to reduce this threat. As you asked in your letter, my testimony covers altematives to civil reprocessing of spent fuel and the application of safeguards to the burgeoning stocks of plutonium.

NUCLEAR MATERIALS CONTROL

With the end of the Cold War, significant quantities and forms of nuclear materials have become excess to national defense needs both in the United States and Russia. On September 27, 1993, President Clinton announced the establishment of a framework for U.S. efforts to prevent the proliferation of weapons of mass destruction. This policy commits the U.S. to undertake a comprehensive approach to the growing accumulation of fissile materials from dismantled nuclear weapons and within civil nuclear programs. As key elements of the President's policy, the United States will:

- Seek to eliminate, where possible, accumulation of stockpiles of highly enriched uranium or plutonium, and to ensure that where these materials already exist they are subject to the highest standards of safety, security, and international accountability.
- Propose a multilateral convention prohibiting the production of highly enriched uranium or plutonium for nuclear explosives purposes or outside international safeguards.
- Encourage more restrictive regional arrangements to constrain fissile material production in regions of instability and high proliferation risk.
- Submit U.S. fissile material no longer needed for our deterrent to inspection by the International Atomic Energy Agency.
- Pursue the purchase of highly enriched uranium from the former Soviet Union and other countries and its conversion to peaceful use as a reactor fuel.
- Explore means to limit the stockpiling of plutonium from civil nuclear programs, and seek to minimize the civil use of highly enriched uranium.
- Initiate a comprehensive review of long-term options for plutonium disposition, taking into account technical, nonproliferation, environmental, budgetary and economic considerations. Russia and other nations with relevant interests and experience will be invited to participate in the study.

BACKGROUND

Spent nuclear fuel reprocessing and uranium enrichment technologies have long been considered sensitive technologies. However, until the 1970's, the United States did not object to adoption of plutonium recycling in civil nuclear programs if strict and effective

controls could be ensured. In the late 1970's, President Carter effectively ended plutonium recycle in the United States and attempted to persuade Japan and Western Europe to do likewise. U.S. efforts to dissuade other nations from pursuing civil uses for plutonium were unsuccessful because of concerns regarding energy dependence, waste disposal and resource utilization, and also perceptions that U.S. persuasion was an attempt to interfere with the decisions of other nations.

The enactment of the Nuclear Non-Proliferation Act of 1978 stipulated that the new peaceful, nuclear cooperation agreements should contain U.S. consent rights over reprocessing of U.S.-origin nuclear fuel. This was the basis for the current Agreement for Cooperation with Japan in which the United States granted long-term prior consent to nuclear fuel reprocessing referred to in President Clinton's policy. The EURATOM agreement, which expires at the end of 1995, does not have a reprocessing consent right and its operation has required a yearly presidential waiver of consent rights since 1978. Negotiations on a new agreement with EURATOM are ongoing.

President Clinton's Nonproliferation and Export Control policy specifically addresses concerns regarding the accumulation of civil plutonium and directs the Executive Branch to explore means to limit the stockpiling of plutonium from civil nuclear programs, and seek to minimize the civil use of highly-enriched uranium. In addition, the United States no longer reprocesses plutonium for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan with regard to prior consent rights.

DIMENSIONS OF THE PROBLEM

During the next 10 to 20 years, civil plutonium will be separated faster than it will be used in reactors. This is partly due to the limited capacity for mixed oxide fuel fabrication. As a result, approximately 20 tons of plutonium will be separated each year, and at most, less than one-half of this would be used in the reactors. Further, the recent National Academy of Sciences report notes that there are already roughly 80 to 90 tons of excess separated civilian plutonium in store around the world today. Security and accountability of plutonium stockpiles are extremely important. Given economic, environmental, geographic and proliferation concerns, many question whether additional plutonium should be separated.

PROLIFERATION CONCERNS

These expanding stockpiles of plutonium resulting from civil reprocessing are a growing proliferation concern. All nuclear reactors fueled with natural or low enriched uranium generate plutonium. When spent fuel from power reactors is recycled,

uranium and plutonium are separated for use in fabricating mixed oxide fuel. Plutonium separated from reprocessing of spent fuel can be used to make nuclear weapons, even though it is more radioactive and less sophisticated from a military standpoint. One spent fuel load from a typical nuclear power plant contains enough plutonium for many weapons. Hence reprocessing is a sensitive technology.

At this time, large numbers of nuclear weapons are being dismantled in the U.S. and Russia. Countries reprocessing civil spent fuel point to this military plutonium as a much bigger proliferation risk than any amount of civil plutonium under IAEA safeguards.

REDUCING THE RISKS WITH THE SPENT FUEL STANDARD

Spent fuel is highly radioactive and must be handled remotely. Plutonium in spent fuel is considered a relatively low proliferation risk because the radioactivity in the fuel is a tremendous danger to anyone who is exposed to it, and because it must be reprocessed before it is available for weapons use. This level of proliferation resistance provides a standard against which to evaluate alternative measures for plutonium disposition. It is referred to as the 'spent fuel standard'. The degree of difficulty of handling spent fuel decreases with time as the spent fuel cools. After about 50 years, the spent fuel is still lethal at close distances, but it can be handled with much less equipment. This underlines the need for an ultimate disposition strategy for spent nuclear fuel.

SAFEGUARDING OF PLUTONIUM

The two commercial reprocessing facilities in France and United Kingdom are subject to EURATOM safeguards and a substantial inspection effort is carried out at those facilities, including resident inspectors. Certain areas of these facilities are also safeguarded by the International Atomic Energy Agency. In addition, other nuclear facilities in the European community at which plutonium is used, including fuel fabrication facilities and power reactors, are also subject to EURATOM and International Atomic Energy Agency safeguards under the terms of the International Atomic Energy Agency/EURATOM New Partnership agreement. In Japan and Switzerland, which are parties to the Nuclear Non-Proliferation Treaty, International Atomic Energy Agency safeguards apply to all the plutonium activities. All these countries operate effective state systems of accounting and control for nuclear materials as required to facilitate the application of IAEA safeguards. Finally, these states are parties to the Convention on the Physical Protection of nuclear materials and maintain physical security measures consistent with those required by international standards.

CUSTOMERS AND SUPPLIERS OF REPROCESSING MARKETS

France and Japan are widely considered the most strongly committed to recycling plutonium (and uranium) for their nuclear energy programs, and are the largest users of reprocessing. The United Kingdom and France are the largest suppliers of reprocessing services, with construction of large capacity planned in Japan in the future. Other countries, such as Switzerland, Germany and Belgium have equities as either customers for or suppliers of reprocessing of spent fuel. Russia may seek to expand reprocessing to satisfy domestic needs in mixed-oxide fuel and future breeder programs and may consider it for commerce with other states. The U.S. strongly discourages reprocessing in regions of proliferation risk.

MOTIVATIONS FOR REPROCESSING

When today's reprocessing plants were planned, it was assumed that they would be needed to separate the initial plutonium loads for breeder reactors. Breeder reactor designs were planned to reduce the need for uranium in nuclear power generation by as much as 99 percent. However, nations attracted by this rationale have underestimated the time, environmental and waste consequences, costs and political consensus required to develop a viable production-scale breeder reactor. In addition, the high-level waste produced from reprocessing is very difficult and dangerous to worker health, safety and the environment. This has left nations in the position of needing to utilize their separated plutonium in mixed oxide fuel for light water reactors which generates a uranium savings of 35 percent at best. The marginal economics of this cycle as well as the high costs and inconveniences of storing and utilizing the separated plutonium, have caused many inside and outside the United States to question the viability of plutonium recycling.

Other reasons for reprocessing have included management of limited on-site fuel storage capacity. In the 1970's and 1980's, countries with growing nuclear energy programs sought to match spent fuel discharge rates with reprocessing capacities. However, the economics of plutonium recycling and its commercial viability have not materialized.

Licensing criteria in some countries have been changed to allow reactors to operate only if there is a way to dispose of or recycle the spent fuel. In cases where spent fuel storage is limited, these regulations effectively forced utilities to have their fuel reprocessed. However, in the last 2-3 years there has been much greater acceptance of and interest in spent fuel storage and so has joined reprocessing as a 'live option' for many European utilities.

POLICY CONSIDERATIONS

Recently, there has been much discussion concerning the fact that many countries are struggling to justify reprocessing technology, but cannot find the technical, environmental and policy solutions for disposition of spent nuclear fuel and its byproducts.

From the Department of Energy's perspective, a very difficult problem confronting the world community is the existing surplus stocks of plutonium. Even if total cessation of reprocessing were to occur, there would still be a large stockpile for disposition. Continued reprocessing simply adds to those stockpiles.

Because plutonium from spent fuel reprocessing can be used in nuclear weapons, its accumulation creates serious proliferation and security dangers. Consistent with Presidential policy, the Department will seek technical, environmental, economically attractive alternatives to offer for plutonium disposition.

In the President's September 27, 1993 speech at the United Nations, he noted: "The United States does not encourage the civil use of plutonium and accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes" The Department of Energy has concluded that continued support, even at an early stage of development, of a technology that has its probable application in the exploitation of plutonium from commercial sources as a fuel source for commercial energy is inconsistent with the example to be set by the Administration in reducing the fissile materials traded in commerce to fuel reactors. It is difficult to urge others not to deploy technologies for burning plutonium for commercial applications if we subsidize development of those or related technologies. Accordingly, the Administration decided, shortly before transmittal of the FY 1995 budget request, to propose the termination of the Actinide Recycle Program at the end of this fiscal year.

CONTROL AND DISPOSITION OF EXCESS WEAPONS PLUTONIUM

In addition to President Clinton's Nonproliferation and Export Control Policy, the agreements reached with Russian President Yeltsin in January set an ambitious agenda for the control and disposition of excess plutonium from dismantled nuclear weapons. This agenda includes transparency and irreversibility in weapons dismantlement, as well as ultimate disposition options.

RECENT AGREEMENTS

Just last week, the Department announced two historic agreements reached with the Ministry of Atomic Energy (MINATOM) of the Russian Federation. These agreements

will further the goals of reducing the proliferation of nuclear weapons. First, in a protocol, DOE has agreed to help find ways to provide alternatives to plutonium production reactors for district heating and electricity at Tomsk and Krasnoyarsk. Within one year after creation of an alternate source of energy, the Russian side would cease production and chemical separation of weapons-grade plutonium.

In addition, the Russian side proposed that, upon approval by the Government of the Russian Federation, the heads of the Russian and U.S. governments enter into a mutual agreement to cease military use of plutonium separated after the date of the agreement. The Russian side noted that both of these cessation and compliance provisions must be met and that the agreement would require that each side permit inspection of its relevant plutonium production facilities as well as storage sites for the plutonium produced by the reactors in Tomsk and Krasnoyarsk.

Second, in a joint statement, DOE and MINATOM declared their intention to conduct inspections of facilities containing plutonium removed from nuclear weapons by the end of 1994. A meeting of experts to establish the procedures for these visits will take place within two months. The Department will work cooperatively with the Departments of State and Defense and the Arms Control and Disarmament Agency in implementing these agreements.

Also last week, the final step was taken to allow implementation of our purchase of Russian highly enriched uranium from nuclear weapons. On March 18, the Department of Energy and the Ministry of Atomic Energy signed a transparency agreement on the provisions to provide confidence that U.S. purchases of low-enriched uranium come from blended-down highly enriched uranium from Russian nuclear weapons while respecting Russian security and sovereignty needs. This agreement helps form the foundation of future follow-on fissile materials verification initiatives.

The Department has also announced its intention to begin International Atomic Energy Agency inspection of some amount of highly enriched uranium located at Vault 16 at the Y-12 Plant by the end of September, and has formally requested the Department of State to take the necessary steps to add Vault 16 to the voluntary safeguards list. In addition, President Clinton and President Yeltsin agreed to on January 14, 1994 to establish a joint working group to pursue additional steps to ensure the transparency and irreversibility of the process of reduction of nuclear weapons, including the possibility of putting a portion of fissionable material under IAEA safeguards.

SAFE, SECURE DISMANTLEMENT

The Department of Energy is involved in many critical aspects of the safe, secure dismantlement of nuclear weapons in the former Soviet Union. These activities include:

- Fissile Material Containers -- designing and manufacturing containers for transportation and storage of fissile material from dismantled Russian nuclear weapons;
- Railcar Upgrade Kits -- designing and modifying existing Russian railcars to enhance the security and safety of nuclear weapons during rail transport;
- Soft Armor Blankets -- providing soft armor blankets to enhance nuclear weapons protection;
- Material Control and Accounting and Physical Protection -- developing and implementing enhanced national systems of material control and accounting and physical protection of special nuclear materials in Russia; and
- Fissile Material Storage Facility -- assisting the Corps of Engineers in design of a Material Control and Accounting and Physical Protection System, safety analysis for the facility and other design assistance related to fissile material storage as required.

DOE ORGANIZATIONAL ALIGNMENT

During the past few months, the Secretary has concluded that an innovative organizational approach was needed within the Department to help improve the coordination and implementation of efforts to address fissile materials management. In response, the Secretary created a high-level cross-cutting project reporting to the Under Secretary. The project is staffed full-time by experienced people from across the Departmental organizations who deal with fissile materials management issues. The project team has the talent and capacity to reach across and promptly engage all elements of the Department on fissile materials issues. Key objectives of the Department-wide project include:

1) Provide safe, secure, and environmentally sound control, storage and ultimate disposition of surplus fissile materials;

2) Promote effective nonproliferation policies and set an example for other nations to follow; and

3) Operate in an open and transparent manner and ensure stakeholder participation in the decisionmaking process.

In addition, the project coordinates the Department's participation in the Interagency Working Group activities involving fissile materials management. The President has tasked the Interagency Working Group to initiate a comprehensive review of long-term options for plutonium disposition taking into account technical, nonproliferation, environmental, budgetary, and economic considerations. The Department is a key contributor to these efforts.

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CONTROL OF NUCLEAR MATERIALS

Comprehensive control and management of nuclear materials must include safeguards on the production of new materials, existing inventories of materials and nuclear materials resulting from the weapons assembly and disassembly process. In each of these areas the Department will examine the unilateral, bilateral and international monitoring options.

On March 15, 1994, Secretary O'Leary took an important step in establishing baseline information about the status of plutonium stocks by directing DOE's Office of Environment, Safety and Health to conduct a comprehensive assessment of the environment, safety and health vulnerabilities associated with the entire inventory of plutonium in storage outside of intact nuclear weapons. This assessment will serve as the information base to identify corrective actions and options for the safe management of surplus fissile materials. This assessment should be completed by September 30, 1994.

Last year, the Office of Technology Assessment identified that a continuing lack of public credibility may have a major impact on progress on dismantlement and on implementing key operational decisions. The President has tasked the Nuclear Weapons Council to identify those quantities of nuclear materials which are excess to national security needs and can be subjected to external inspection. Our goal is to be able to declassify sufficient information about these surplus materials to allow informed public debate on storage and disposition options. However, we will continue to protect information that could assist a potential proliferant.

Declassification of sufficient information about fissile materials is part of the Secretary's efforts to build public trust by providing information that is important to the current debate about the proper management and disposition of these materials. Release of this previously secret information will be used to encourage other nations to reciprocate and declassify similar information.

The Department is also establishing an international nuclear material tracking capability and to integrate international and domestic capabilities. When implemented, in early 1995, this system will greatly contribute to the world-wide control of nuclear materials.

DISPOSITION OF NUCLEAR MATERIALS

As part of the Interagency review directed by the President, the Department is evaluating a number of options for plutonium and highly enriched uranium disposition. Options being considered involve the interim, long term and ultimate solutions. Our goals are to reduce the global nuclear danger by providing a basis for engaging the

Russians on arrangements to safely dispose of weapons capable fissile materials, and to provide comprehensive technical, environmental, economic and scheduling data to support decisions on plutonium disposition options.

The recent National Academy of Sciences report on Management and Disposition of Excess Weapons Plutonium provides a useful framework for addressing these issues. To support the Interagency review, the Department of Energy will begin a public scoping process on the options for plutonium control and disposition and develop criteria for screening out unacceptable options. We will then begin technical evaluations of a reasonable range of options to support informed policy decisions.

The Department's ultimate objective is to provide safe, secure, and environmentally sound control, storage and ultimate disposition of surplus nuclear materials. In accomplishing this goal, DOE will operate in an open and transparent manner and ensure stakeholder participation in the decisionmaking process. In so doing, the Department's efforts will promote nonproliferation policies and set an example for other nations to follow.

CONCLUSION

Reducing the continuing and new nuclear dangers that the world faces; responding with programs that build upon and enhance the technical and operational strengths of the Department and its laboratories and emphasizing commitments to environment, safety, and health are the essence of the Department's implementation of the President's national security strategy. The Department is committed to remain a full participant in preventing the spread of nuclear weapons, materials, and expertise and in supporting safe, environmentally sound control and disposition of nuclear materials that could contribute to proliferation.

Mr. Chairman, this concludes my prepared statement. At this time, I would be happy to answer any questions the subcommittee members may have.

STATEMENT

Catherine McArdle Kelleher

Senior Fellow
Foreign Policy Studies Program
The Brookings Institution
and
Vice-Chair
Committee on International Security and Arms Control
National Academy of Sciences

March 23, 1994
Subcommittee on International Security, International Organizations, and Human Rights
Committee on Foreign Affairs
U.S. House of Representatives

Mr. Chairman, members of the subcommittee; thank you for the opportunity to present the views of the Committee on International Security and Arms Control (CISAC) of the National Academy of Sciences (NAS) on the problem of the accumulation of plutonium, especially excess weapons plutonium.

In January CISAC released the results of an 18-month study **Management and Disposition of Excess Weapons Plutonium**, an analysis of the technical and policy options regarding the excess weapons plutonium that will result from current and future arms reductions. The study, conducted for the United States government under the primary sponsorship of the National Security Council and the Department of Energy, was led by Prof. Wolfgang K. H. Panofsky, Director Emeritus of the Stanford Linear Accelerator Center and Chair Emeritus of CISAC. The study has met with considerable interest both within our government and throughout the world. It has, for example, formed a baseline for

an internal Department of Energy Review about the future control and disposition of fissile materials now declared excess. It has also been briefed and discussed by CISAC members at a number of informal but high level meetings throughout Europe, in Japan and in China.

A second related study is now nearing completion, and will be reflected in my remarks. A Panel on Reactor-Related Options for Plutonium Disposition -- consisting of three members of CISAC plus four other individuals chosen for their nuclear-energy-technology expertise, and chaired by CISAC Chair John P. Holdren of the University of California at Berkeley -- was convened by the NAS to assist with the analysis of options in which the plutonium is used as fuel in reactors or is mixed with radioactive wastes from reactors. The Panel's findings are summarized in the first CISAC report and will be described in greater detail in a separate Reactor Panel report to be released later this spring.

The CISAC reports cover all phases of the excess weapons plutonium problem, from the dismantlement of nuclear warheads, through the intermediate storage of the fissile materials they contain, to ultimate disposition of the excess plutonium. Today I want to address two particular aspects of this problem as, from CISAC's perspective, it relates to the American and Russian policies: the proposed cut-off of production of fissile materials for weapons and our ability to safeguard and secure the quantities of plutonium that will be becoming available. Third, I

and only several kilograms of plutonium --fewer if it is separated weapons-grade, somewhat more if it is "reactor-grade"--are needed to produce a bomb. Therefore, all of the weapons usable material--plutonium of any grade whether separated or not, and HEU at a minimum-- should figure in any credible plan for fissile material control and disposition.

Civilian stocks of plutonium are estimated to be as large as perhaps five or six times the military stocks, and are growing by 60 to 70 tons a year. Some of this civilian stock growth will result from commitments made in the 1970s and in the early 1980s by Japan, Britain and France if all three countries carry out their present plans for civilian power applications. These governments understandably face considerable pressure to exploit the plutonium and related facilities in which sunk costs are high, to prove the continuing wisdom of decisions made under very different international and technological circumstances. This seems true even when the actual or foreseeable economic gain over the use, for example, of the more available, lower-priced LEU to generate power, is nonexistent or negative.

Yet it is now absolutely clear that such policies only contribute to the oversupply of these materials for which there is no simple long-term nor even short-term storage or disposal solution. Moreover, the vulnerability of these materials to attack or to diversion poses significant risks, more significant now than before given the increased importance attached to a strengthened global non-proliferation regime. Thus the

measures taken to address the urgent problem of managing excess nuclear weapons and fissile materials in Russia and the United States must be seen not only as ends in themselves, but also as steps toward an overall regime designed to achieve higher standards of security and transparency for the total global stocks of fissile materials.

For Russia and the United States, therefore, the Committee envisions a reciprocal regime, built in stages, that will include:

1. reciprocal declarations of total stocks of nuclear weapons and fissile materials;

2. cooperative measures to confirm and clarify those declarations;

3. agreed, monitored subtractions from the stocks available for military use, including:

a. monitored warhead dismantlement,

b. commitments never again to use agreed quantities of fissile materials for weapons purposes,

c. safeguarded storage and long-term disposition of excess fissile material stocks, and

4. agreement on and monitoring of additions to those stocks, including whatever warhead assembly continues, and a verified cutoff of production of fissile materials for weapons.

Such a regime, if agreed between the United States and Russia, will directly serve the key security objectives of limiting the risk of theft, limiting the risk of reversibility or " breakout," and strengthening arms reduction and nonproliferation efforts world-wide. It will also provide a sound base for building a global regime for the control and ultimate

disposition for all weapons useable fissile materials. Although complex and far-reaching, such a regime can be approached incrementally, contributing to confidence at each step while posing little risk.

Only the first few elements of this broad regime is currently in place. The end of the Cold War offers an opportunity to begin building it that is both unprecedented and unlikely to be repeated. The Clinton administration, in its nonproliferation initiative of September 27, 1993, took the opening steps in this direction. On December 7, 1993, Energy Secretary Hazel O'Leary began a new regime of transparency and openness when she declassified the amount of weapons-grade plutonium that the United States has produced and the amounts held at several Department of Energy (DOE) sites. More remains to be disclosed, and the Committee with others looks forward to the promised next range of disclosures scheduled for June. The last months have also seen significant progress toward Russian-American agreement on critical control issues, including the agreements signed last week by Secretary O'Leary and her Russian counterpart, Minister Viktor Mikhailov.

But there is still far more to be done, and there is great urgency to the tasks, an urgency not always recognized in present American discussions or in the pace of the implementing measures following expressions of Congressional intent. The Committee found that the risks and the threats associated with loosened control over weapons and fissile materials in the former Soviet

Union represented "a clear and present danger" to the national security of the United States. Achieving substantial improvements in the management and control of these weapons and materials in the former Soviet Union will require reciprocal action by the United States across all aspects of the regime governing present and potential weapons-useable material stocks.

CISAC recommends that the United States and Russia immediately commit a substantial fraction of the weapons plutonium that each declares to be excess to non-weapons use. As the recent Russian- American agreements emphasize, it is critically important for both bilateral reassurance and to give a strong global non-proliferation signal that no new military fissile materials are produced. The monitored transfer of large quantities of existing materials to peaceful purposes, combined with a fissile material production cutoff will provide a demonstrable sign of progress critical for the NPT extension considerations, a clear capping and reduction of the total potential size of the nuclear arsenals that can be produced. The United States has stopped production of fissile materials for weapons and has recently proposed a global convention ending such production. Russia has for some time produced no HEU but has continued to produce weapons-grade plutonium.

An important achievement of the Clinton administration, therefore, is the March 17 announcement by the U.S. Department of Energy outlining two plutonium production limitation agreements with Russia. The first agreement allows each side access to the

dismantlement sites at Tomsk and Pantex for the purpose of monitoring and therefore verifying the fundamental facts of weapons dismantlement. In the second accord, Russia has agreed to discontinue weapons grade plutonium production at three plants in Siberia as soon as alternative heating sources for the surrounding regions, funded with some new American assistance, are available. The Russian government had argued earlier that the remaining three plutonium production reactors were necessary commercial power producers for the surrounding areas, and that their spent fuel had to be reprocessed for logistical and safety reasons.

Although both sides concede the agreements will take several years to fulfill, the Clinton administrations' September 1993 nonproliferation initiative deemed it essential, for both substantive and symbolic reasons, that this continuing Russian production of weapons plutonium be ended expeditiously. Moreover, in this as in other issues, the complex politics of related or secondary questions, such as the future of nuclear power worldwide or the needs for environmental safety in Russia, should not be allowed to interfere with accomplishing the first priority, shutting down this production as soon as possible, and bringing all existing weapons useable stocks under control.

CISAC is further convinced that a cutoff of fissile material production could be monitored with relative ease by using a combination of national technical means of intelligence and inspections of fissile material facilities. The current Russia-

U.S. agreements begin with bilateral monitoring. Such facilities can and should as quickly as possible be placed under IAEA safeguards comparable to those in place in non-nuclear-weapon states; this would allow a global cutoff agreement to be nondiscriminating. Less intrusive transparency measures will probably suffice, since the goal would be to detect militarily significant production in states already possessing substantial stockpiles of nuclear weapons.

Most, if not all, of the regime we recommend can and should be extended worldwide. The standards set in managing U.S. and Russian excess weapons and fissile materials can provide the base for improving management of these items throughout the world, and the opportunity to do so should be taken. As the Clinton administration's statement on nonproliferation policy put it, world stocks of fissile materials should be "subject to the highest standards of safety, security, and international accountability."

Declarations of weapons holdings should be made by all the declared nuclear-weapon states, while declarations of fissile material holdings (at least plutonium and HEU) should ultimately be made by all states. Such universal reporting of stocks of fissile material, which should include information on all imports and exports of fissile materials, would complement the information that the non-nuclear-weapon parties to the NPT are already required to give to the IAEA. This will provide a substantially firmer base for planning international fissile material management policy, and constitute an essential aspect of a strategy for the next phases of nonproliferation

efforts.

Making a cutoff of production of fissile materials for weapons a global accord, as the Clinton Administration has proposed, will mark a major step forward in nonproliferation efforts. A global cutoff will establish the fundamental principle that it is no longer legitimate for any state to produce the essential ingredients of nuclear weapons, except for peaceful purposes under safeguards. If states such as Israel, Pakistan, and India can be convinced to accept such an agreement, it will cap their undeclared arsenals without requiring them to either acknowledge or roll back those arsenals immediately. Such a first step, for example, will go a long way toward limiting the potential for a further nuclear arms race on the South Asian subcontinent.

Safeguarding and Securing the Excess Plutonium

The risks of theft or diversion of fissile materials — or even assembled weapons — in the former Soviet Union represent a quantum increase in the anxieties about theft and diversion that began with the nuclear revolution itself. The time to insure adequate arrangements for security and accounting is yesterday, as many of the Russian officials responsible have acknowledged. Every day that goes by, every weakening of the basic custodial and control arrangements in the former Soviet Union adds risks that fissile materials may be stolen and wind up in the hands of potential proliferators.

The Russian-American agreements on HEU and on dismantlement monitoring, and the planned construction of a fissile material stor-

age site in Russia are important steps to lower these risks, as are the several channels for continuing consultation and technical exchange. But most deal only with fissile materials from weapons dismantlement that Russia considers excess. Yet there are substantial additional stocks of fissile materials not incorporated in weapons throughout the Russian nuclear weapons complex; as, for example, substantial stocks of civilian separated plutonium at the Mayak reprocessing plant; and a wide variety of military and civilian research facilities with more than enough fissile materials for a bomb. Nuclear materials in Ukraine, Kazakhstan, and other former Soviet states must also be adequately secured and brought into an inclusive accounting and control regime.

The United States is working with several of the states of the former Soviet Union to provide assistance in improving security and accounting for these nuclear materials. But until recently, only very limited steps had been taken; the scale of the efforts actually underway is very small in comparison to the magnitude of the task to be done. The IAEA and other countries also plan to provide limited assistance in material control and accounting, but none on a scale comparable even to the U.S. effort. The IAEA, for example, simply lacks the necessary resources.

Throughout the process, all efforts have been slowed by the ongoing political uncertainty and turmoil in the former Soviet Union, with the problems of divided authority and inter-agency disputes, the continuing legacy of secrecy and mistrust, the lack of priority and political impetus, and limited funds. But, even with the best of

intentions and with Congressional support as early as possible, Western efforts have too often been too slow or too limited in scope given the urgency of the tasks and the potential dangers involved. Accounting regimes, the establishment of baseline measurements, would seem perhaps the easiest and the most logical of the initial control tasks on which cooperation would be beneficial. Yet, although an initial agreement on accounting assistance was drawn up in the spring of 1993, for example, it took nearly half a year of review by Russia before it was finally signed in September 1993. The United States has at times seemed strangely reluctant to emphasize the significance and the broad-reaching implications of this effort. And implementation so far -- and the limited nature of the two model projects -- has been partial and somewhat unsatisfactory.

CISAC recommends a more urgent and comprehensive approach at a significantly higher level of funding, with an emphasis on cooperation in addressing the most immediate risks. Time is most definitely not on the side of those seeking control; and it may well be that the resources and the access needed to use them are of limited feasibility. Western countries, including the United States, should press Russia and the other states of the former Soviet Union to take a number of steps urgently —- within weeks or months, rather than years — and they should be willing to provide necessary equipment and funds for these purposes.

In particular, Western countries should press for and offer assistance for the following:

- Immediate installation of appropriate perimeter/portal-monitoring systems to detect any theft of fissile materials, as well as

adequate armed guard forces, at all sites where enough weapons-usable fissile material to make a nuclear weapon is stored.

- An urgent program of security and accounting inspections and improvements at all of these sites. As recently as the mid-1980s, the United States undertook such a crash program at its own nuclear weapons complex, and made critical improvements, such as the installation of portal monitors, within days of the initial inspection in some cases.

- Improved economic conditions as soon as possible for personnel responsible for accounting and security for weapons and fissile materials, to reduce incentives for corruption and insider theft. This requires not only acceleration of existing plans for the International Science Center arrangements but also creation of a number of options and alternatives, potentially through lab-to-lab programs with American and European counterparts.

- Improved national oversight of security and safeguards, with a strengthened basis in law. In Russia, this would involve strengthening the role of GOSATOMNADZOR, while in other former Soviet states it would involve strengthening or creating comparable organizations.

- Consolidation of fissile material storage and handling where possible.

- Conversion of research reactors to run on low-enriched uranium (LEU) fuels, reducing the number of sites where weapons-grade fissile materials are used.

- Greater Western participation and cooperation in safeguards and security, ideally at all fissile material sites, but at all civilian sites at a minimum. This might begin with exchanges of information concerning security procedures at each of the sites where significant quantities of fissile materials are stored and handled, ideally supplemented by visits to each of these sites, to provide the basis for more educated offers of assistance in making improvements. These initial exchanges should be followed by establishing in-depth working-level cooperation on means to improve security and safeguards.

- Regularized, as well as emergency, working-level cooperation in monitoring reports of alleged diversions. Currently, consultations on such reports are generally carried out at a high and rather formal level, with much helpful detail omitted. The states of the former Soviet Union are likely to have the best information on thieves and dealers within their borders, whereas outside states may have better information on the network of buyers. Working together would help the relevant intelligence agencies respond to these myriad reports.

To help overcome current Russian resistance to Western participation in improving safeguards and security at military sites, the United States should be quite open about the problems it has uncovered in the past in its own weapons complex, and should be prepared to offer information about and access to U.S. sites. Such an offer might be desirable even if it were not required for political reciprocity, in order to demonstrate the security procedures used in the U.S. system.

Joint U.S.-Russian development of improved technologies for accounting and security for nuclear materials would also be valuable, providing practical tools to reduce serious risks, while at the same time making productive use of the talents of former weapons scientists and engineers on both sides. Ties already in place between the various Russian and American weapons laboratories could provide useable channels for the rapid initiation of a creative R&D program.

Ultimately, it would be desirable if the high standard for security and material accounting that should be set for the planned jointly built storage facility were applied to <u>all</u> fissile materials in Russia. One means to achieve this would be for Russia to follow the same approach that DOE plans for the United States, consolidating all of its stored plutonium and HEU at a single site. As at the U.S. site, IAEA safeguards such as those advocated in this chapter might be applied at that storage site, possibly with the portion of the material still reserved for weapons use held in a separate area not subject to inspection, or subject to less intrusive measures. Such a dual approach would require significantly expanding the size of the

storage facility currently planned or making explicit provision for possible subsequent construction of additional modules.

The advantages of such an approach are sufficiently compelling that the Committee believes the United States should begin to discuss it with Russia. It should be remembered, however, that even after such consolidation, a number of facilities would remain at which working stocks of fissile materials would have to be accounted for and secured.

Alternatively, if the material cannot be brought to the storage facility, some of the cooperative approaches to be developed for the storage facility might be brought to the material. It might be desirable, for example, to have joint perimeter monitoring at existing fissile material sites to guard against theft. This would complement the perimeter monitoring that each side already has in place (or should be urged to put in place) at its own sites. For example, a small cadre of individuals from the United States could take up residence at each of the major Russian sites, taking part in portal inspections to ensure that fissile material was not being removed without authorization. This would go a long way toward resolving doubts and uncertainties concerning the myriad reports of diversion now appearing, since any effort to bribe or overwhelm the portal guards would then have to include foreign personnel at the site as well.

Although the main problem in this area, at present, is likely to be in Russia, such a program would certainly require offering comparable access to U.S. sites. Since perimeter-monitoring systems

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under each sides own control already exist, such joint cooperation might be set up quickly once a decision was made, with a minimum of added intrusion on activities at the sites. In particular, the perimeter monitors would not necessarily need to be informed about any of the activities going on within the site; they would only oversee the guards who check materials that leave the facility.

CISAC believes that measures such as these could potentially provide large security benefits for modest costs and should be addressed immediately.

The Challenge of Controlling Civilian Plutonium and HEU Stocks Worldwide

As discussed above, a number of countries in Europe and Asia are still pursuing nuclear fuel cycles that involve the use, processing, and transport of separated plutonium. In addition, HEU is used in research reactors. These materials are usable for nuclear weapons, and therefore their use requires careful attention to safeguards and security to mitigate the proliferation risks. Standards of safeguards and security for these materials vary widely and are less stringent than those applied to similar materials in military use. This situation needs to be changed.

To mitigate these proliferation risks and manage the politics surrounding the use of these materials, some have advocated a regime internationalizing the storage (and possibly use) of these materials, in a concept the IAEA is now calling an "international management

regime." Safeguarded storage for excess fissile materials from dismantled weapons in the United States and Russia can and should be seen as a first step toward building such a broader regime. Negotiations should be pursued to:

1. create a global cutoff of all unsafeguarded production of fissile materials;

2. use the U.S.-Russian safeguarded storage regime recommended above as a base for a broad international storage and management regime for fissile materials, including registration and safeguards for all civilian separated plutonium and HEU;

3. extend the U.S.-Russian declaratory regime mentioned above to a global regime of public declarations of stocks of fissile materials;

4. agree on higher standards of physical security for these materials, with an international organization given authority to inspect sites to monitor whether the standards are met; and

5. agree on cooperative international approaches to manage the reprocessing and use of plutonium to avoid building up excess stocks.

The proliferation risks from civilian plutonium and HEU programs justify greater efforts and expenses to mitigate them than are applied today. In particular, safeguards and security for civilian separated plutonium and HEU should be increased to a level comparable to those applied to plutonium in military stocks. States using nuclear power should also reexamine the adequacy of their measures to ensure against diversion of spent fuel. Spent fuel that is decades old is of greater concern than fresh spent fuel, and should meet special standards; ultimately, very old spent fuel will have to be subject to security comparable to that used for unirradiated plutonium-bearing materials. Applicable international standards on these points should be revised to reflect these perspectives.

THE BROOKINGS INSTITUTION

1775 MASSACHUSETTS AVENUE, N.W. WASHINGTON, D.C. 20036-2188
TELEPHONE: 202/797-6000 FAX: 202/797-6004

Foreign Policy Studies Program

Biographical Sketch

Catherine McArdle Kelleher is a Senior Fellow in the Foreign Policy Studies Program at the Brookings Institution. Her current project at Brookings, Germany Reborn, seeks to place German unification in the framework of changes in German foreign policy and European security in the 1980s and 1990s.

Kelleher was formerly the director of the Center for International Security Studies (CISSM) and a professor in the School of Public Affairs at the University of Maryland. She has taught at the National War College and at the universities of Denver and Michigan. Kelleher served as a staff member for the National Security Council in the Carter Administration, and was a research fellow at the International Institute for Strategic Studies in London. She has served as a consultant to government and public sector organizations, and to several private foundations.

Kelleher has published widely in the field of national security and arms control studies, and has been active in the design and implementation of programs to broaden education in this field. Her most recent publications include "Cooperative Security in Europe" in Janne E. Nolan, ed., Global Engagement: Cooperative Security in the 21st Century (Washington, D.C.: Brookings, 1994); Management and Disposition of Excess Weapons Plutonium, contributing author, National Academy of Sciences, Committee on International Security and Arms Control (January, 1994); "Cooperative Security in Europe: A New Order for the 1990s," in Stephen Szabo and Douglas Stuart, eds., Arnold Wolfers (John Hopkins University Press, 1994); and "Soldiering On: U.S. Public Opinion on the Use of Force," Brookings Review, vol. 12 (Spring 1994).

Kelleher received her undergraduate training at Mount Holyoke College and her doctorate in Political Science from the Massachusetts Institute of Technology. She is a member of the Council of the International Institute for Strategic Studies, is Vice-Chair of the Committee on International Security and Arms Control of the National Academy of Sciences, and is president of Women in International Security (WIIS).

T E S T I M O N Y

RAND

Limiting the Accumulation of Weapon-Usable Plutonium

Brian G. Chow

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Limiting the Accumulation of Weapon-Usable Plutonium

Brian G Chow[1]
RAND
PO Box 2138, 1700 Main Street
Santa Monica, CA 90407-2138

Prepared statement for a hearing on
Stemming the Plutonium Tide:
Limiting the Accumulation of Weapon-Usable Nuclear Material
before the
Subcommittee on International Security, International Organizations and Human Rights
House Committee on Foreign Affairs
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[1]Brian Chow is a senior physical scientist at RAND and has published extensively on nuclear proliferation issues since 1974. He received a Ph.D. in physics from Case Western Reserve University and a Ph.D. in finance from the University of Michigan. The views and recommendations presented in this testimony are solely those of the author and do not necessarily represent those of RAND or any of its research sponsors.

I appreciate the opportunity to share my views on the spread of plutonium with members of the Subcommittee. For this testimony, I will focus on three areas. First, what are the problems arising from the spread of plutonium? Second, are the steps being taken by the United States and other countries sufficient to stem the plutonium tide? Third, what other measures need to be implemented by the United States and other countries?

Problems of Separated Plutonium

There are basically two categories of plutonium issues--those associated with plutonium still in the spent fuel and those with plutonium separated from the spent fuel. The concern of the former is that, eventually, the radiation from spent fuel will drop so much that national or subnational groups can reprocess the spent fuel quickly and easily for plutonium. Although such plutonium would likely be only of reactor-grade, it could still be used to make nuclear bombs with yields in the kiloton range or more. This is a long-term issue that the world has to deal with sooner or later. Since this hearing is focused, however, on separated plutonium, I will restrict my comments to that. Separated plutonium is a more immediate and urgent issue, because the most difficult task of extracting plutonium from the intensively radioactive spent fuel has already been performed; the remaining steps of incorporating the material into a nuclear bomb are much easier.

Separated plutonium comes from both nuclear weapon programs and civilian nuclear power. It has been reported that Russia's recent agreement to shut down three nuclear reactors still producing weapon-grade plutonium will make Russia the last of the five declared nuclear states to stop producing fissile materials for warheads.[2] Even if no more weapon-grade plutonium will be produced, the United States and former Soviet republics (FSRs) each will have about 100 metric tons of surplus plutonium from the dismantled nuclear weapons by the year 2003. Only about five kilograms of such plutonium is needed to make a primitive nuclear weapon in the kiloton range. On the civilian side, 330 metric tons of reactor-grade plutonium will have been separated from spent fuel worldwide and be available for use by the year 2003. About seven kilograms of reactor-grade plutonium is needed for a bomb in the kiloton range. Countries that are currently reprocessing spent fuel for civilian purposes are France, FSRs, the U.K., Japan, India, Israel and N. Korea. Although the last three countries are claiming a civilian intent for their reprocessing activities, some or all of the plutonium they have separated is mostly likely used in their undeclared nuclear weapon programs. It is the difficulty of ascertaining the real purpose that makes civilian reprocessing dangerous as well.

Military plutonium and civilian plutonium face two common problems. First, it is the diversion of plutonium by terrorist groups. An economy involving extensive use of military or civilian plutonium would make it much more difficult for the International Atomic Energy Agency (IAEA) to safeguard so much plutonium, because it would appear in so many places with multiple vulnerable nodes--reprocessing plants, fabrication plants,

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[2] "Russia Agrees to Close Reactors, End Production of Plutonium," *Los Angeles Times*, March 17, 1994, p. A4.

storage facilities, reactor sites and, most troublesome of all, the transportation network on land, at sea and in the air. IAEA safeguards can be effective, but only if the world does not create, in the first place, an impossible environment for the IAEA to operate in. Allowing massive use of plutonium in civilian nuclear power comes close to be such a hostile environment. As to keeping separated plutonium in FSRs, their economic destitution makes nuclear theft an ever present danger.

Second, it is the seizure of plutonium by host countries. The IAEA or any other organization cannot prevent countries from seizing plutonium that is located within their territories. The United States should be concerned about the political instability in the FSRs. If Russia reverts to tyranny, stored nuclear materials, even if they are safeguarded by the IAEA and a bilateral arrangement, might be refashioned into nuclear weapons. I am also worried about even legal transfer of separated plutonium from FSRs to other countries for civilian use. Although the recipients would likely be restricted to industrialized countries such as Japan, it would eventually be difficult for the world to draw an equitable line dividing those countries which can have separated plutonium and those which cannot. Countries with good nonproliferation credentials now could turn bad in the future. Had the United States helped the Shah of Iran develop a civilian plutonium reprocessing capability, as it had done with many other programs, the ayatollah would have had separated plutonium now for its nuclear weapon development program.

Why, then, would countries want to introduce the problematic plutonium into commerce? From the dawn of the nuclear age to the seventies, countries thought that the uranium resources were running out fast and that plutonium would be needed soon. Since the eighties when civilian nuclear power growth has been revised severely downward and additional types and amounts of uranium have been discovered, some countries remain worried that they would not have sufficient time to develop an alternative to plutonium. In RAND's recent study[3], we found that plutonium use will be uneconomical for the next 30-50 years or even much longer. Moreover, there will always be enough plutonium in the spent fuel to support even the most optimistic plutonium-based breeder buildup, in the event that breeders are needed unexpectedly. Therefore, countries do not have to plunge into plutonium use prematurely. It is disappointing to see that, while countries are reiterating their commitment to nonproliferation, they are not willing to forego even their uneconomical plutonium activities, which raise grave proliferation concerns.

Current Measures to Deal with Separated Plutonium

From the start, President Clinton has considered limiting nuclear proliferation to be one of the top priority items on his administration's agenda. In his Nonproliferation and Export Control Policy issued last September, he seeks "to eliminate where possible the accumulation of stockpiles of highly-enriched uranium or plutonium," and proposes "a multilateral convention prohibiting the production of highly-enriched uranium or plutonium for nuclear explosives purposes or outside of international safeguards." These

[3] Brian G Chow and Kenneth A Solomon, *Limiting the Spread of Weapon-Usable Fissile Materials*, MR-346-USDP, November 1993.

aims are worthy, but additional steps, which I shall soon discuss in the next section, must be taken to meet those aims. Otherwise, the elimination of plutonium accumulation might be understood to mean the prompt use of separated plutonium in commerce so as to reduce the size of the plutonium stockpile; in that event, the policy would result in sanctioning plutonium use. Similarly, halting fissile material production only for weapons would not prevent rogue countries from continuing their nuclear weapon development, because they would simply claim that their production is for civilian nuclear power programs. Already, countries such as N. Korea are using such claim for their weapon programs. Rogue countries could carry on parallel, covert programs to develop, simulate or even test all components of nuclear weapons, except the insertion of the plutonium pit into the weapon and the testing of the completed weapon. Even if the separated plutonium is under full-scope IAEA safeguards, these countries can at will seize the plutonium for weapons use, and the warning time, measured merely in days or weeks, is so short that the international community will not be able to stop the bomb-making process. While many countries will never develop nuclear weapons even if they had the capability to do so, some countries might be tempted by the potential of bringing themselves close to the nuclear threshold covertly or even legitimately.

As to dealing with weapon-grade plutonium from the FSRs' dismantled nuclear weapons, many planners both inside and outside of the government are seriously considering the placement of plutonium in the FSRs under the IAEA and/or bilateral safeguards. I would argue that this arrangement is inadequate, because it does not prevent Russia from using the weapon-grade plutonium to re-establish its massive nuclear arsenal, in the event that the likes of Zhirinovsky gain power.

Additional Measures to Deal with Separated Plutonium

Any effective counter-plutonium policy must deal with both military and civilian plutonium. Any policy dealing with military plutonium alone is at best inadequate and at worst gives a false sense of security; it would allow proliferators to proceed uncomfortably close to nuclear status with little impediment and even with much outside civilian nuclear assistance, that is readily applicable to their military pursuits. The drafters of the Non-Proliferation Treaty insisted from the start that nuclear weapons and peaceful nuclear devices not be treated differently. We should now insist that facilities associated with nuclear weapon materials and facilities associated with sensitive civilian nuclear materials, including plutonium, also not be treated differently. It would be futile to ban military nuclear facilities but not sensitive civilian nuclear facilities in nonnuclear weapon states.

Therefore, the United States' counter-plutonium policy should have two objectives. First, it should take weapon-grade plutonium out of the FSRs' hands. Second, it should discourage both military and civilian plutonium separation and use worldwide.

The first objective can be accomplished by offering to purchase all of the FSRs' weapon-grade plutonium for, say, $1 billion, as the United States has agreed to buy the

low-enriched uranium blended down from 500 metric tons of the FSRs' highly-enriched uranium. Since I am concerned that the uranium purchase would not be budget-neutral, I would further recommend that the United States ask other countries' help in purchasing such uranium directly from the FSRs or repurchasing it indirectly through the United States. The money we save can be used to lighten the burden of our plutonium purchase.

There is a distinct possibility, however, that Russia would refuse to let its weapon-grade plutonium leave the FSRs, even after our best effort. Another option would be to encourage the FSRs to bury their weapon-grade plutonium after it is mixed with high-level waste. Unfortunately, the FSRs might not have enough high level waste left. Mixing weapon-grade plutonium with spent fuel would require the chopping up of spent fuel and would be expensive. Vitrifying the plutonium alone or with some radioactive isotopes such as cesium-137 would be inadequate, because the FSRs would have the capability to extract the weapon-grade plutonium quickly. Between storing weapon-grade plutonium in FSRs under safeguard and burning it in the FSRs' reactors, the United States should prefer the latter. The former runs the risk of returning such plutonium to nuclear weapons, while the latter at least turns the weapon-grade plutonium into reactor-grade plutonium. While this grade distinction is much less important in nonnuclear weapon states, it is important in the FSRs. The FSRs have already designed, tested and built many delivery platforms for their nuclear weapons. If they had to use reactor-grade plutonium instead for their nuclear rearmament, redesigning and re-testing their nuclear weapons and delivery platforms would be costly and time-consuming for them. The costs and delays could serve as a deterrent to rearmament, even if their political system changes for the worse.

As to the second objective of discouraging plutonium use, the Administration's current position is "not to encourage the civil use of plutonium and accordingly does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan." The United States needs to take some further steps to assure other countries that they can maintain energy security without resorting to plutonium activities now and that they can share in the benefits of plutonium-based reactors, if they ever turn economical. These steps include

- Prolonging the world's reliance on existing reactors in the once-through mode. This entails improving the reactors' efficiency and identifying additional uranium resources at current and higher prices.

- Encouraging development of advanced nuclear reactors that would be safer and even more efficient and proliferation-resistant. These advanced reactors do not have to be breeders; near-breeders or highly efficient converters will do. Both uranium- and thorium-based fuel cycles should be considered.

- Confining sensitive civilian nuclear materials and facilities within the five currently declared nuclear weapon states to the extent possible, while agreeing to share the benefits, if any, of these activities with other nations. I acknowledge that exceptions may have to be made for Japanese and some other countries' facilities

that are already in operation. Still, these countries should scale back their plutonium activities.

Concluding Remarks

Since the dawn of the nuclear age, countries had planned to use plutonium in their civilian nuclear programs. Even when countries now recognize that the date for economic use of plutonium will be distant and that the threat of North Korea's plutonium-based nuclear weapon program is serious, halting the momentum toward a plutonium economy is still a daunting task. But, the chance to change the nuclear course is now better than ever. Many countries, including some of the most ardent plutonium supporters such as France, Germany, and the U.K., have scaled back their plutonium activities as a result of political and economic pressure. Even Japan's plutonium program faces delays. Considering that a continuation of the past course would lead to many countries being situated dangerously and ambiguously near the nuclear threshold, we have no alternative but to make a serious attempt to stem the plutonium tide.

Brian G Chow

Brian Chow is a senior physical scientist in RAND's Defense and Technology Planning Department. He joined RAND in 1989 after serving as a senior research specialist at Pan Heuristics, R&D Associates for ten years. In addition to performing policy studies for government agencies since 1978, Dr. Chow was appointed as a consultant to the Office of the Chief of Naval Operations (1989-1990), to the President's Science Adviser (1988-1989), and to the Under Secretary of Defense for Policy (1987-1988).

As project leader of three recent studies on nuclear and missile nonproliferation, he designed strategies that allow the United States and other countries to forgo proliferation-sensitive activities in civilian nuclear power, military nuclear materials and space launchers without losing major economic opportunities. His latest monographs in this area are *Limiting the Spread of Weapon-Usable Fissile Materials* and *Emerging National Space Launch Programs: Economics and Safeguards*. His other research interests include national and international nuclear energy policies, fuel cycle alternatives, military space policies, arms export control, ballistic missile defense and cruise missile submarines. He has authored more than sixty publications and has been listed in 18 biographical references.

He received a Ph.D. (1969) in physics from Case Western Reserve University and an M.B.A. (1977) and a Ph.D. (1980) in finance from the University of Michigan.

NUCLEAR CONTROL
INSTITUTE

1000 CONNECTICUT AVE NW SUITE 704 WASHINGTON DC 20036 202•822•8444 FAX 202•452•0892

Testimony of Paul Leventhal
President, Nuclear Control Institute
before the
Subcommittee on International Security,
International Organizations and Human Rights
of the
Committee on Foreign Affairs
U.S. House of Representatives
Washington, D.C.
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Overview

Mr. Chairman and Members of the Subcommittee: I am Paul Leventhal, president of the Nuclear Control Institute, a non-profit research center on nuclear proliferation problems. Our deputy director, Daniel Horner, assisted in the preparation of this testimony.

Thank you for inviting me to "assess the risk to international security posed by the rapid accumulation of plutonium and examine what may be done to reduce this threat." In my view, the risk is high, and the only effective way to reduce that risk is to avoid production and use of separated plutonium altogether---or at least to avoid the stockpiling of hundreds of tons of it worldwide that is now projected in the decades ahead.

The U.S. government should be giving the risks of civilian plutonium the high-priority attention now being given to the risks of military plutonium. The two highly authoritative reports prepared and discussed by my fellow panelists underscore the importance of a well-coordinated effort to deal effectively with excess military and civilian plutonium.

The National Academy's report, Management and Disposition of Excess Weapons Plutonium, says that "the risks posed by all forms of plutonium must be addressed" and goes on to say that "further steps should be taken to reduce the proliferation risks posed by all of the world's plutonium stocks, military and civilian, separated and unseparated...." [Emphasis in original.] The RAND report, Limiting the Spread of Weapon-Usable Fissile Materials, makes a similar point:

> It is critical that countries pay attention to the proliferation threat from the civilian side if they want to maximize the nonproliferation value of dismantling U.S. nuclear weapons and those of the FSRs [former Soviet

republics]. If countries ignore the civilian threat, they can compound the problem by making wrong choices in how to deal with military materials."

Unfortunately, the administration has not taken that approach. The President's non-proliferation policy statement of last fall asserted that "[t]he U.S. will undertake a comprehensive approach to the growing accumulation of fissile material from dismantled nuclear weapons and within civil nuclear programs." But the statement also makes clear that the United States will not actively discourage the very large civilian plutonium programs now getting underway in Western Europe, Japan and Russia.

The United States has proven itself extremely reluctant to raise objections to long-standing and prospective allies over these programs, at least not in a voice loud enough to be heard. The administration's failure to effectively challenge British preparations for the start-up of the Thermal Oxide Reprocessing Plant (THORP) or to question the need for the Swiss request to retransfer and reprocess U.S.-origin spent fuel provide recent examples.

In contrast to a concerted U.S. effort on military plutonium, and on military and civilian highly-enriched uranium, U.S. diplomacy is all but ignoring civilian plutonium. Yet, civilian reprocessing programs will be by far the largest source of weapons-usable fissionable material in the coming decades if these programs go forward as planned. The spread of civilian plutonium in quantities that dwarf existing weapons stocks could yet evolve into the world's most severe nuclear-proliferation threat.

There have been high-level calls within the administration for attention to this subject. Last September, then-Under Secretary of Defense John Deutch wrote a memo in which he said, "I believe that the Clinton-Gore administration should mount an initiative to address the long-term issue of Pu [plutonium] disposal." According to Deutch, the first item of this initiative would be gaining international agreement on "the desirability to reduce the world inventory of separated Pu to the lowest levels practicable." Deutch suggested that the National Security Council form an interagency working group on this issue, and he called for an NSC-chaired meeting to discuss the subject.

Energy Secretary O'Leary also has taken a number of initiatives in this regard, the most recent being to begin a review of alternatives to reprocessing. The Department of Energy has been in the forefront on the civilian plutonium issue, sometimes in the face of indifference or hostility from other agencies. The administration as a whole, however, has not yet risen to the challenge.

The RAND and National Academy studies, which emphasize the importance of confronting a double challenge of military and civilian plutonium, were completed after the administration announced its non-proliferation policy last September. My principal recommendation is that the administration reopen its non-proliferation policy review on fissile materials so that it can address these important findings.

In my testimony, I outline what I regard as the shortcomings of U.S. plutonium policy and the ways they serve to undercut U.S. non-proliferation objectives. I offer some recommendations for strengthening the policy and for pursuing initiatives for "Stemming

the Plutonium Tide." in keeping with the title of this hearing. that could lead to a more secure world.

The initiatives I propose relate to ongoing diplomatic efforts that are within the purview of this committee---namely, negotiations of an extension of the Nuclear Non-Proliferation Treaty (NPT), of a treaty to cut off production of fissile materials for weapons, and of new agreements for nuclear cooperation with Europe. I hope, therefore, that the committee will keep a close watch on how the negotiations proceed and the extent to which the administration uses them to come to grips with the civilian plutonium problem.

Shortcomings in U.S. Plutonium Policy

For the past 13 years, the U.S. government has refused to address squarely the danger of civilian plutonium. The Clinton administration's policy in practice has proved to be only marginally different from that devised over a decade ago by President Reagan's ambassador for non-proliferation, Richard T. Kennedy, and carried over to the Bush administration. That policy declared the United States would "not inhibit or set back" the use of plutonium recovered from U.S.-supplied nuclear fuel by nations "with advanced nuclear power programs where it does not constitute a proliferation risk"---that is, Japan and Western Europe. Thus, the Reagan-Bush policy was highly discriminatory, allowing Western European countries and Japan to have access to U.S.-origin plutonium while denying it to others.

The Clinton administration has made a limited improvement by pledging to "[s]eek to eliminate where possible the accumulation of stockpiles of highly-enriched uranium or plutonium...." The administration also declared, "The United States does not encourage the civil use of plutonium...." But the policy statement undercut these commitments by also saying, "The United States, however, will maintain its existing commitments regarding the use of plutonium in civil nuclear programs in Europe and Japan." Thus, the new policy statement represents some improvement in rhetoric over its predecessor, but in practical terms, the difference between the policies is negligible. A plutonium double standard still eviscerates U.S. non-proliferation policy.

Diplomacy, of course, often requires the practice of artful discrimination, but there is a catch when one is dealing with plutonium. The half-life of plutonium-239 (the most desirable isotope for bomb-makers) is 24,000 years---and it eventually decays into uranium-235, the other nuclear explosive material, which has a shelf life even longer than plutonium's. Thus, by granting consent to a country to acquire plutonium from U.S.-supplied nuclear fuel, the United States is expressing confidence that the country's intentions will remain peaceful indefinitely and that plutonium commerce, once begun with "trustworthy" states, will not spread to other, less trustworthy states or to terrorists, over time.

That is a lot to ask, particularly in light of recent history. It's a safe bet that we would not have sent highly enriched uranium to the Shah of Iran if we had known he would be overthrown by the Ayatollah Khomeini. Similarly, it is also safe to say we would

not have allied ourselves with Iraq against Iran and sent Saddam Hussein $1.5 billion worth of dual-use items that could be applied to making nuclear weapons and other weapons of mass destruction if we had known we soon would have to send U.S. troops into battle to destroy these weapons.

Practicing a double standard on plutonium hobbles U.S. nuclear non-proliferation diplomacy. I would be curious to know, for example, how the United States Government explains to South Korea why we are objecting to that country's plutonium ambitions while giving Japan a 30-year, blanket approval to accumulate a superpower quantity of plutonium.

U.S. efforts on controlling civilian plutonium stand in stark contrast to those on highly enriched uranium (HEU), where the Clinton administration's diplomacy has been creative and aggressive. On HEU, the United States has been willing to revise its "existing commitments" by refusing to export HEU in the interest of nonproliferation; yet, the same policy presumably rules out revising commitments on plutonium.

The Clinton administration should conduct a bottom-up review of its non-proliferation policy. Policymakers should ask, "What are the elements of an effective non-proliferation policy?" not "Considering the policy we now have, what we can make out of it without ruffling any feathers?" They should be willing to press for new arrangements to prevent commerce in plutonium, and press for them with the same vigor and skill they are now using to prevent commerce in HEU. There needs to be a change in both the substance of the policy and the attitude with which it is pursued.

Strengthening U.S. Plutonium Policy

The two reports prepared by my colleagues on the panel provide an ample basis for reopening the policy review and, in particular, for giving high priority to civil plutonium.

Under its nuclear agreements with Japan and the European Atomic Energy Community (EURATOM), the United States has not exercised its legal prerogatives under the Atomic Energy Act and the Nuclear Non-Proliferation Act with regard to giving case-by-case consideration to requests for reprocessing of U.S.-origin fuels in those countries. But the United States clearly is not barred from using political means to influence the countries involved to explore alternatives to reprocessing. Such an approach need not be confrontational; indeed, it should not be.

A broad range of alternatives should be explored, but all should meet two important criteria. First, the ultimate disposition of plutonium under each alternative must satisfy the National Academy's "spent fuel standard"---that is, keep the plutonium in spent fuel or, where it already has been separated from spent fuel, put it in another form of equivalent proliferation resistance.

Second, the proposed alternative must advance the goal of reducing and discouraging plutonium separation and use, in the long term as well as the near term. Therefore, proposals that call for fabricating current plutonium surpluses into plutonium-uranium

"mixed-oxide" (MOX) fuel should be unacceptable since such plans would stimulate the MOX industry and contradict the administration's overall policy of discouraging plutonium use.

I regard the most attractive current possibilities to be:

Dry storage of spent fuel and vitrified waste pending final disposal. Except for Japan, the countries that have reprocessing contracts with Britain and France are not seeking plutonium. They simply are seeking a way to rid themselves of their spent fuel. They are saddled with reprocessing contracts signed years ago, when the diseconomics, environmental hazards, and proliferation risks of reprocessing were not as clear as they are today.

Abandoning reprocessing in favor of dry storage of spent fuel is gaining widespread support. As the Economist noted with regard to the impending start-up of the THORP reprocessing plant, "It is now clear that the dry storage of spent fuel from light-water reactors is cheaper than reprocessing it. It may also be safer." Under this alternative, "[u]tilities in Germany, Japan and five other countries would be spared the opprobrium of dealing with reprocessed fuel that THORP would return to them, or the expense of paying to store plutonium and waste [resulting from reprocessing] at Sellafield. And the world would be spared the creation of more plutonium." [Economist, November 20, 1993, p. 20]

A study conducted by Japan's Central Research Institute of the Electric Power Industry (CRIEPI) examined the option of adding interim spent fuel storage capacity as an alternative to immediate reprocessing of spent fuel. The study concluded that "in the long-term nuclear strategy, the interim storage of spent fuels provides the most economical option for adjusting the plutonium supply/demand." The authors also noted that "the option of interim spent fuel storage makes it possible to adjust the timing of reprocessing, [and] thus provides flexibility for the fuel cycle policy to cope with the uncertainty surrounding the nuclear development." Japan and other nations should seriously consider this option as an economic and proliferation-resistant alternative to reprocessing. [K. Nagano & K. Yamaji, "A Study on the Needs and Economics of Spent Fuel Storage in Japan," in High Level Radioactive Waste and Spent Fuel Management, Vol. II, Ed. S.C. Slate et al., 1989, p. 473]

Although it would have been in the long-term interests of both the reprocessor (Britain) and its principal customer (Japan) to opt for dry storage rather than reprocessing at THORP, neither side seemed willing to risk the financial penalties and political fallout that presumably would result from initiating a change in the contract. Had the United States been willing to intervene, it could have helped broker an agreement that would have benefitted all parties. The THORP contracts could have been revised to provide for dry storage rather than reprocessing of Japanese spent fuel, and Japan could have been provided with low enriched uranium with an energy content equivalent to the plutonium it would have received.

Marketing low enriched uranium (LEU) on attractive terms to encourage uranium stockpiling. The Nuclear Control Institute recently completed a study

demonstrating that Japan could save tens of billions of dollars by accumulating a strategic reserve of uranium and at the same time could avoid the proliferation risks and political liabilities of plutonium.

A Japanese Strategic Uranium Reserve would provide an energy-security benefit similar in concept but far greater in duration than that provided by the Strategic Petroleum Reserve now maintained by Japan. The petroleum reserve guarantees a few months' supply of fuel, but a uranium reserve, because of the much greater energy content of nuclear fuel, can guarantee a supply for decades.

The reserve would provide a 50-year, energy-secure timeframe within which Japan could develop the commercial breeder reactor later on, if it ever proved necessary. In the meantime, the reserve presents Japan a major opportunity to assist Russia economically and to get a big dividend in return through purchases of huge amounts of inexpensive Russian natural uranium. The good will resulting from such a Japanese-Russian deal could also contribute to settlement of the Kurile Islands dispute.

The reserve also would enable Japan to avoid controversy and instability in the Asia-Pacific region that could be sparked by renewed sea shipments---and stepped-up acquisition---of plutonium, at a time when Japan wants the support of its neighbors for a seat on the UN Security Council. Japan's deferral of a commercial plutonium program would make a major contribution to ongoing efforts to keep the Korean peninsula free of nuclear weapons and weapons-usable nuclear material. (I am submitting our study with a request that it be appended to the hearing record.)

I would like to emphasize that these two options are complementary. Uranium stockpiling presents clear advantages over reprocessing in providing energy security, since low-enriched uranium is cheaper and more proliferation-resistant than plutonium. From a waste-management standpoint, the advantages of dry storage over reprocessing are similar, and storage does not generate the additional radioactive waste that reprocessing does. Thus, there are environmental, economic, and non-proliferation benefits to these two alternatives.

Other approaches. Another potentially attractive alternative is U.S. purchase of already-separated plutonium. Late last year, it was reported in the trade press [Nuclear Fuel, December 20, 1993, page 5] that the German nuclear power industry had made an informal request to transfer its already-separated plutonium to the United States under perpetual safeguards. The proposal is intriguing and deserving of close study. Before I would put it on a par with the other two---dry storage and uranium stockpiling---several key commitments would be required from both sides. For example, Germany would have to forgo any further reprocessing, and the United States would have to dispose of the plutonium as waste rather than fissioning it in reactors. Without such commitments, this proposal would not meet the all-important criterion of reduction and discouragement of plutonium separation and use.

If the United States is to discourage civil use of plutonium around the globe, it must seize every possible opportunity to indicate that disposal as waste, not production and stockpiling, is the accepted norm for dealing with separated plutonium. This imperative has

major implications for the pending U.S. decision on disposition of plutonium from dismantled nuclear weapons.

The Clinton administration should be guided every step of the way by the National Academy of Sciences' "Fuel Cycle Policy Signal" criterion---that is, the administration should select only from the disposition options such as vitrification that the NAS says "would send the signal that even for the pressing problem of plutonium disposition, the United States did not approve of the use of plutonium fuels."

Fissioning the weapons plutonium in reactors would not meet this criterion. Such a decision would send the signal that plutonium has value as a nuclear fuel and, therefore, would undermine U.S. non-proliferation efforts.

In this regard, I am encouraged by the decision of the Department of Energy to cancel the advanced liquid metal reactor (ALMR) and actinide recycling programs. This decision, and the way the Secretary O'Leary has presented it, constitute a major step in the right direction. First, the Secretary made a clear link between domestic and foreign treatment of plutonium: She said that "continued support of the IFR would make it difficult, if not impossible, for the United States to help lead the world in reducing the threat of plutonium proliferation." She emphasized that we cannot urge other countries to refrain from pursuing reprocessing and breeder programs if we are pursuing such programs ourselves. Removing this technology from consideration as a plutonium-disposition option surely will strengthen our non-proliferation diplomacy---with the Russians on plutonium disposition, and with all countries considering reprocessing.

But the Secretary went further than that. She indicated that the ALMR is objectionable not only because it is a reprocessing and breeder technology, a feature that makes it uniquely distasteful among the disposition options, but also because it involves use of plutonium as fuel---a feature that is, of course, common to all the reactor options for disposition. Thus, the Secretary seems to be indicating that she is inclined toward the non-reactor options for plutonium disposition---a crucial non-proliferation step, as I explained earlier.

Furthermore, she explicitly made the connection to foreign plutonium use. In a recent statement she said, "This civil use of plutonium is an action the administration is seeking to reduce around the globe." That aspect of the ALMR decision was strongly reinforced by the fact that it terminated a joint research effort with Japan, for which Japan was providing strong diplomatic and financial support. The ALMR cancellation therefore was, to my knowledge, the first public break with overseas plutonium programs since 1981.

The administration is also to be commended for its actions with regard to the other nuclear explosive material, highly enriched uranium (HEU). In my view, the administration has been creative and aggressive in fulfilling its commitment to eliminate the civil use of highly enriched uranium.

The Department of Energy and the Department of State have demonstrated a strong commitment to restarting the take-back of U.S.-origin, bomb-grade uranium fuel from

foreign research reactors. This program, known as the Off-Site Fuels Policy, was stalled for more than five years due to the indifference and inattention of preceding administrations. Secretary O'Leary went the extra mile by declaring her willingness to invoke the emergency procedures of the National Environmental Policy Act in order to ensure the retrieval of U.S.-origin HEU. While that step ultimately proved unnecessary, DOE is on schedule to accept the first return of U.S.-origin HEU in six years this spring, following completion of an ongoing Environmental Assessment.

The administration also has begun to demonstrate increased support for the related Reduced Enrichment for Research and Test Reactors (RERTR) Program, clarifying that its goal is "to convert all research and test reactors to run on low enriched uranium instead of highly enriched uranium." [Viewgraph, Office of Intelligence and National Security, U.S. Department of Energy, February 10, 1994] We understand the administration is requesting ongoing funding for cooperation on a Russian RERTR program, begun in Fiscal Year 1994, and will soon arrange funding to restart development of high-density LEU fuels---an integral part of the RERTR Program that was terminated prematurely by the preceding administration---in order to enable the conversion of all remaining HEU-fueled research reactors.

Four additional actions have demonstrated the administration's commitment to eliminating HEU commerce. First, following an NCI petition to the Nuclear Regulatory Commission, the administration blocked a proposed export of HEU fuel to France until it obtained firm commitments from Cogema and EURATOM that the HEU would be blended down to LEU. Second, the administration persuaded the operator of a EURATOM research reactor in the Netherlands to convert to LEU by announcing its refusal to take back the reactor's mounting spent-fuel inventory unless the reactor were converted. Third, the administration has initiated a feasibility study to explore conversion to LEU of DOE's planned research reactor, the Advanced Neutron Source. Were the U.S. to build a new reactor fueled with HEU, it would have a devastating impact on the RERTR program. Fourth, the administration is actively exploring the conversion of existing DOE research reactors to LEU, to remove any lingering appearance of discrimination.

Pursuing Initiatives

A comparable international effort to rid the world of separated plutonium should be pursued by the administration. I propose the following three initiatives:

NPT. It is widely recognized that the Nuclear Non-Proliferation Treaty (NPT) discriminates between weapon states and non-weapon states by legitimating the status of the declared weapon states. To its credit, the United States has taken a number of steps, to reduce the discriminatory aspects of the Treaty, including implementing sharp reductions in warheads and pursuing a Comprehensive Test Ban. But U.S. plutonium-use policy is having precisely the opposite effect. It produces a different, but no less pernicious, form of discrimination by allowing some non-weapon states (Japan and the Western European countries) to have access to plutonium separated from U.S.-supplied fuel while denying it to others.

By allowing commerce in this weapons-usable nuclear material, the appetites of other nations for plutonium are being whetted and the fundamental goal of the Treaty---to prevent the spread of nuclear weapons---is severely undermined. This situation raises serious questions about the equity and the effectiveness of the NPT.

When the NPT entered into force 23 years ago, the economic case for plutonium seemed obvious, as did the ability of the treaty's inspection arm---the International Atomic Energy Agency---to safeguard the material effectively. It was also assumed, incorrectly, that because plutonium created in power reactors was not ideal for making weapons, it could not be used in weapons.

Over the past quarter century, the world has learned much about "peaceful" plutonium---its weapons utility, its diseconomics, the extreme difficulty of safeguarding it to ensure that the few kilograms needed for a bomb do not fall into the wrong hands. Particularly in light of the Treaty's three-month withdrawal provision, separation of plutonium is fundamentally incompatible with the goals of the NPT. The United States should be working to remedy this weakness of the Treaty at the same time it is pressing for indefinite and unconditional extension. (I am submitting for the record a paper prepared by our counsel explaining how the NPT regime can be strengthened in this way, without amending the Treaty.)

EURATOM. Just when the United States should be (and claims to be) working to eliminate as many asymmetries as possible in the non-proliferation regime, it appears ready to perpetuate a two-tiered plutonium regime by means of renegotiation of its agreement for nuclear cooperation with the European Atomic Energy Community (EURATOM). In order to avoid the requirement of the Nuclear Non-Proliferation Act (NNPA) of 1978 for so-called "case-by-case" consent rights for reprocessing of U.S.-origin spent fuel, the President has exercised the "EURATOM waiver" every year since 1980. The issue is now coming to a head, since the agreement expires next year and cannot be extended through this same waiver process. (I am submitting for the record a detailed analysis by the Nuclear Control Institute of this point and the larger legal and political questions raised by the EURATOM extension.)

The current indications are that U.S. negotiators are willing to press at most for the same sweetheart arrangement we gave Japan in the renegotiation of that nuclear agreement ---that is, a 30-year advance approval for reprocessing of U.S.-origin spent fuel. When the Japan agreement was submitted to Congress in 1987, majorities of the House and Senate foreign affairs committees asserted that the agreement was unlawful because it violated the NNPA's requirement for case-by-case consent rights. The same conclusion was reached by the American Law Division of the Congressional Research Service and the Comptroller General of the United States.

But political and economic arguments for not raising the plutonium question and jeopardizing good relations with Japan were deemed more compelling than the legal and international-security arguments, and the agreement came into force after a failed attempt in the Senate to kill it. Now, seven years later, the legal argument remains sound, and the economic and proliferation case against plutonium is even more persuasive. The

EURATOM agreement, therefore, provides the Executive Branch and the Congress with an opportunity to revisit the mistaken 1987 decision.

Unfortunately, there is no indication that the United States is prepared to raise the crucial issues of U.S. consent over reprocessing and retransfers of U.S.-origin plutonium and HEU within EURATOM. This is a classic case of State Department willingness to sacrifice important non-proliferation objectives for fear of rocking the diplomatic boat.

Fissile Materials Cut-off Convention. The negotiations now getting under way at the Conference on Disarmament in Geneva should be broadened from the current focus on military materials to include a cut-off of separated, civilian plutonium and civilian HEU. The agenda is now limited to a cut-off of dedicated military fissile materials and fissile materials produced outside international safeguards. Since these safeguards cannot provide assurance that material is not being produced for weapons (witness Iraq), this approach is a sure recipe for stimulating regional instabilities, particularly since the current approach to the convention contains no requirement for states to declare pre-existing unsafeguarded stockpiles.

The proposed convention implicitly endorses the continued production of HEU and separated plutonium, as long as these materials are produced under safeguards. Thus, non-NPT states such as India, Pakistan, and Israel; suspect NPT states such as Iran and Iraq; and large-scale reprocessors such as Japan, Britain, and France all could continue producing weapons-usable fissile material without running afoul of the convention.

The convention would be so permissive as to contradict even the limited U.S. non-proliferation policy goal of "encourag[ing] more restrictive regional arrangements to constrain fissile material production in regions of instability and high proliferation risk." In the case of HEU, the convention in its current form could only hurt the ongoing, commendable efforts by the United States to eliminate any further production and use of HEU worldwide.

The proposed convention should be seen as an opportunity to establish a universal regime---that is, one that applies to all plutonium and highly enriched uranium, regardless of its designation as "military" or "civilian." (I submit for the hearing record an open letter our Institute has presented to members of the UN Committee on Disarmament urging them to seek a universal cut-off of weapons-usable fissile materials, just as they are now negotiating a universal test ban.)

If participation in a universal cut-off regime were accepted by plutonium-producing states as a way to avoid creating large surpluses, the objective then could be achievement of an international safeguards regime for verifying the absence of separated plutonium---that is, no production or acquisition of separated plutonium. The present safeguards system has the impossible task of verifying the peaceful use of atom-bomb material. Verifying the absence of separated plutonium is far more straightforward than guaranteeing its peaceful use. Thus, widening the scope of the convention to cut off all production of separated plutonium and highly enriched uranium, as a way to avoid creating large surpluses, makes sense from a technical as well as a policy standpoint.

Conclusion

The agenda I have laid out is an ambitious one. It surely would take some time for the U.S. government to adopt this agenda, let alone to persuade the plutonium states of its value. In the meantime, there is much that can be done, in a narrower and more informal way, to discourage plutonium use.

For example, even if the United States is not yet prepared to advocate including civil plutonium in the fissile material cut-off convention, the Clinton administration should not oppose such a proposal if it is proposed by other countries. The United States should encourage international debate on this and other plutonium issues and should be responsive to requests for technical information.

Indeed, it is essential that the United States speak up on the technical issues and rebut the false claims of plutonium advocates, particularly on the following key points:

Weapons utility. In 1976, the United States released non-classified information confirming that reactor-grade plutonium can be used to make nuclear weapons. More recently, the RAND report noted, "[T]he amount of reactor-grade plutonium needed for a kiloton-range bomb is merely 40 percent more than that needed for a weapon-grade plutonium bomb." The National Academy of Sciences summarized its analysis as follows: "In short, it would be quite possible for a potential proliferator to make a nuclear explosive from reactor-grade plutonium using a simple design that would be assured of having a yield in the range of one to a few kilotons, and more using an advanced design."

The Department of Energy should now prepare another unclassified briefing, modeled on the one in 1976, to rebut Japanese and British claims that reactor-grade plutonium cannot really be used in nuclear weapons. (I have submitted for the hearing record a letter our Institute sent to Secretary O'Leary, making the case for such a briefing.)

Limitations of safeguards. In an analysis prepared for the Nuclear Control Institute, a safeguards expert at the Massachusetts Institute of Technology noted the inability of the IAEA to meet its own detection goals---that is, to detect with a high degree of confidence and on a timely basis a diversion of one "significant quantity" (weapon quantity) of plutonium from a plutonium extraction plant. In fact, in a large reprocessing plant such as the one now under construction at Rokkasho-mura in Japan, measurement uncertainties are so large that dozens of weapon-quantities of plutonium would have to be missing before the IAEA could sound the alarm. (I am submitting this analysis by Dr. Marvin Miller for the hearing record.)

Health hazards. The health effects of plutonium are well established; absorption in the body of microgram quantities can cause cancer. Among the many discussions of this subject, I would cite in particular the relevant sections of the 1990 Science and Global Security article, "The Hazard from Plutonium Dispersal by Nuclear-warhead Accidents," by two scientists who now serve in the Clinton administration.

Diseconomics. An analysis by the Nuclear Control Institute showed that when the price of reprocessing is included, MOX fuel is about four to eight times more expensive than low-enriched uranium fuel. Even if plutonium is assumed to be a "free good," MOX fuel is still far more costly, due to the expensive process required for safely and securely managing highly toxic, weapons-usable plutonium. Nor are plutonium's economic prospects likely to improve for a long time, according to most authorities, including the authors of the RAND report.

None of this information is new, yet the spurious claims persist. The U.S. government should not allow misrepresentations by plutonium advocates to stand unanswered. The Department of Energy, with its technical expertise, has a special role to play. Secretary O'Leary already has shown a keen awareness of that role with her forthright letter calling on the Japanese Power Reactor and Nuclear Fuel Development Corporation (PNC) to withdraw the notorious "Mr. Pluto" video because of its scientific inaccuracies.

In the dozen years since President Reagan reversed the policies of Presidents Ford and Carter and gave U.S. approval to large-scale reprocessing of U.S.-origin spent fuel, we have lost precious time. The arguments in favor of the Ford-Carter policy are even more compelling because the economic rationale for plutonium, flimsy even then, has completely collapsed.

We now have an unprecedented opportunity to reverse the course of the plutonium economy. Reports from Japan indicate a serious reassessment within that country of its plutonium program. Japan is the linchpin of a global plutonium economy, not only because of its own projected, large-scale reprocessing program, but also because it holds a large share of the reprocessing contracts with facilities in Britain and France. Japan's reassessment may have come too late to stop the misguided start-up of THORP, but it should give second thoughts to France about its UP2-800 plant, which has not yet started up, and to Japan about its Rokkasho-mura plant, which is in the early stages of construction. The United States should help to stimulate those second thoughts, in a way it clearly did not in the case of THORP.

We can still modify our non-proliferation policy and help prevent large-scale commerce in plutonium, but we must act quickly or civilian stocks of separated plutonium will soon dwarf the existing military stocks. By then, action to contain the spread and neutralize the danger of commerce in atom bomb material may come too late.

I would be glad to answer any questions that members of the subcommittee may have.

Stemming the Plutonium Tide

March 23, 1994
Subcommittee on International Security

Question from Mr. Lantos for Mr. Wulf
U.S. - EURATOM Negotiations on Agreement for Cooperation

Q. With the U.S. - EURATOM Agreement in the process of being renegotiated, what is the United States doing to ensure that the U.S. achieves meaningful control over U.S.-origin nuclear material in EURATOM?

-- Is the U.S. seeking greater control over reprocessing of U.S.-origin nuclear material?

-- Is the U.S. seeking increased information and control over the end use of U.S.-origin highly enriched uranium, including HEU already exported to EURATOM?

A. In the negotiations on a new U.S. - EURATOM agreement for cooperation the United States is seeking the guarantees, rights, and conditions required by Section 123 of the Atomic Energy Act for such agreements. Among these requirements is a consent right over reprocessing. With regard to your question about specific controls on highly enriched uranium (HEU), Section 123 requires consent rights over storage and alteration in form or content of HEU. We are seeking to have such consent rights cover not only new U.S. exports of HEU (if any), but also HEU subject to the current U.S. - EURATOM agreement for cooperation. The current U.S. - EURATOM agreement for cooperation contains no consent rights over reprocessing, storage, or alteration in form or content.

It should be noted that the United States has offered to exercise certain consent rights in a new U.S. - EURATOM agreement for cooperation on an advance, long-term basis.

QUESTION FROM REPRESENTATIVE BEREUTER

National Academy of Sciences Report

Question 2: This same National Academy report suggested using reactors to dispose of excess plutonium. What is DOE's position on this recommendation?

Answer: We agree that reactor burning of excess plutonium should be considered as a long-term disposition option. The reactor option should be assessed along with other long-term disposition options such as vitrification. The Department will assess a range of long-term disposition options and will perform environmental analyses consistent with the National Environmental Policy Act.

Question for the Record Submitted to
Robert J. Einhorn

House Foreign Affairs Committee
Subcommittee on International Security,
International Organizations and Human Rights

March 23, 1994

Q. With the U.S.-EURATOM Agreement in the process of being renegotiated, what is the United States doing to ensure that the U.S. achieves meaningful control over U.S.-origin nuclear material in EURATOM?

-- Is the U.S. seeking greater control over reprocessing of U.S.-origin nuclear material?

-- Is the U.S. seeking increased information and control over the end use of U.S.-origin highly enriched uranium, including HEU already exported to EURATOM?

A. The United States is seeking to conclude a new agreement for peaceful nuclear cooperation with EURATOM that will include all the conditions and controls called for by section 123 of the Atomic Energy Act of 1954, as amended. A U.S. right of consent to reprocessing of spent fuel subject to the agreement is among the rights that we are seeking to obtain.

With regard to expanding U.S. controls over highly enriched uranium (HEU), section 123 of the Act requires U.S. consent rights over storage and alteration in form or content of HEU. In our negotiations with the European Commission we have proposed that such consent rights be included in the new agreement and cover not only new U.S. exports of HEU (if any), but also HEU subject to the current U.S.-EURATOM agreement for cooperation. (The existing U.S.-EURATOM agreement contains no

consent rights over reprocessing, storage, or alteration in form or content. In the context of including such consent rights in a new agreement, the United States has proposed that they be exercised by both sides on an advance, long-term basis in the agreement itself.) We also hope to establish mechanisms, probably in an administrative arrangement associated with the new agreement, for the parties to exchange information regarding their respective nuclear programs, including information on HEU use.

RAND

Limiting the Spread of Weapon-Usable Fissile Materials

Brian G. Chow,
Kenneth A. Solomon

Prepared for the
Under Secretary of Defense for Policy

National Defense
Research Institute

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SUMMARY

Since 1991, the governments of the United States and the former Soviet republics (FSRs), and the public worldwide, have become concerned about the rapid accumulation of weapon-usable fissile materials[1] from dismantled nuclear warheads. The fear is that mismanagement might result in some of the materials being refashioned into nuclear weapons, either by national or subnational groups or, if Russia or other nuclear republics revert to tyranny, by the republics themselves.

This study, however, found that countries including the United States have paid inadequate attention to an equally if not more serious potential danger on the civilian side. Current plans for civilian nuclear development worldwide call for the separation of more weapon-usable plutonium from spent fuel[2] by the year 2003 than from dismantled nuclear weapons. Another problem is the existence of commercial gas centrifuge and other sensitive[3] enrichment plants

[1]Weapon-usable fissile materials are defined as uranium with a fissile isotopic content of 20 percent or more and plutonium of any isotopic composition. Weapon-usable plutonium includes plutonium separated from the typical spent fuel of commercial nuclear reactors (reactor-grade plutonium) and plutonium from nuclear weapons (weapon-grade plutonium). On the other hand, plutonium before being separated from the intensely radioactive spent fuel is not considered as weapon-usable fissile material in this study.

[2]In this report, we define spent fuel as discharges from nuclear reactors before reprocessing to recover plutonium and uranium. Waste is defined as the aqueous streams containing dissolved spent fuel after plutonium and uranium have been recovered.

[3]For this report, sensitive civilian nuclear facilities are defined as those that can produce, separate, or handle weapon-usable fissile materials. These facilities include plants for plutonium reprocessing and fabrication, plutonium-fueled reactors, and at

in nonnuclear weapon states. Countries with separated plutonium or these enrichment facilities within their borders can, at will, produce materials for nuclear weapon use within days or weeks. No safeguard scheme, including that of the International Atomic Energy Agency (IAEA), can be effective if such sensitive materials and facilities are widely available in nonnuclear weapon states. The drafters of the Non-Proliferation Treaty (NPT) insisted at the outset that nuclear weapons and peaceful nuclear devices not be treated differently. We now argue that nuclear production facilities and sensitive civilian facilities also should not be treated differently; they should be confined to the currently declared five nuclear weapon states. A few exceptions, such as the Joyo and Monju breeders in Japan and the Urenco enrichment plants in the Netherlands, may need to be tolerated. Countries, however, should be encouraged to phase out their plutonium and enrichment activities or at least not to expand or build more.

It is critical that countries pay attention to the proliferation threat from the civilian side if they want to maximize the nonproliferation value of dismantling U.S. nuclear weapons and those of the FSRs. If countries ignore the civilian threat, they can compound the problem by making wrong choices in how to deal with military materials. As an example, some planners recommend burning weapon-grade plutonium in nonnuclear weapon states. This would actually encourage the civilian use of plutonium in those states.

This study recommends that the United States initiate and encourage countries to undertake a four-element program for managing civilian nuclear development. The elements are (1) terminating or drastically reducing both military and civilian plutonium activities worldwide, (2) prolonging the world's reliance on current once-through[4] and proliferation-resistant modes of nuclear plant operations, (3) focusing existing advanced nuclear reactor developmental programs on reactors (without plutonium reprocessing) that

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least some of the plants for uranium enrichment. But a typical commercial nuclear reactor is not considered a sensitive nuclear facility, because it does not use weapon-usable fissile materials in its fuel and its produced plutonium is still embedded in intensely radioactive spent fuel.

[4]Almost all the current commercial nuclear reactors worldwide operate in the once-through mode, in which the plutonium and uranium in the spent fuel are not reused.

consume much less uranium and are more proliferation-resistant than current reactors, and (4) negotiating an international arrangement that allows sensitive civilian nuclear materials and facilities to exist and operate only in the five currently declared nuclear weapon states and that agrees on the sharing of benefits, if any, with nonnuclear weapon states. This four-element program would allow countries to use peaceful nuclear energy further into the future, with far less nuclear proliferation risk.

After delineating this four-element program, the study proposes complementary actions to deal with fissile materials from dismantled nuclear weapons. Whatever is done to these military materials should meet two criteria. First, the actions should prevent FSRs as much as possible from ever fashioning these high-grade fissile materials back into nuclear weapons or selling them to nonnuclear countries or groups. Second, any actions taken should not hinder the international movement toward a proliferation-resistant future. Both criteria can be met by blending down the highly enriched uranium (HEU),[5] as both the Bush and the Clinton administrations have asked FSRs to do, and by purchasing weapon-grade plutonium from the FSRs. However, the United States is currently undecided on a course for plutonium. Storing and safeguarding plutonium in FSRs, as many planners propose, does not prevent FSRs from reusing the plutonium for bombs if FSRs politically change for the worse.

We propose in this study that the United States reduce its $8 billion to $12 billion[6] commitment by asking other countries to help purchase uranium blended down from FSR HEU. In this way, the United States can spend more on the purchase and management of FSR weapon-grade plutonium, which is much more difficult to make weapon-nonusable than HEU. Finally, the United States can give its own HEU and weapon-grade plutonium the same treatment as FSR

[5]In this report, we define highly enriched uranium as uranium with 90 percent or more fissile uranium isotopes.

[6]All dollar amounts in this report are in 1992 U.S. dollars unless specified otherwise. The $8 billion is calculated by assuming a 10 percent discount rate and the $12 billion is the undiscounted amount. The HEU value to FSRs is $6 billion to $9 billion correspondingly, because they will have to spend $2 billion to $3 billion to blend their HEU into low-enriched uranium.

materials, but allowance should be made for the differences between these countries' requirements for such materials (such as the need for HEU in U.S. naval reactors) and between their abilities to produce such materials quickly (such as the capability of FSR RBMK power plants to produce weapon-grade plutonium quickly after treaty abrogation).

RAPID ACCUMULATION OF WEAPON-USABLE MATERIALS

Preventing nuclear materials from falling into illegitimate hands has always been the most important technical element in international nuclear safeguards, and rightly so. If weapon-usable fissile materials became readily available commercially to both nuclear and nonnuclear weapon states, an effective control would be infeasible. Weapon-usable fissile materials could come from two sources: One is from dismantled nuclear weapons in the FSRs and United States. We estimate that over the next 10 years 200 tonnes of plutonium and 1,000 tonnes of HEU will be recovered from those dismantled weapons.

A second source is the plutonium reprocessed from the spent fuel of commercial power plants. We estimate that through the year 2003, 330 tonnes of reactor-grade plutonium will be separated from spent fuel. The diversion of even a tiny fraction of these materials will be enough to make many nuclear weapons. Only about 5 kg of weapon-grade plutonium or 15 kg of HEU are needed to make a primitive nuclear weapon in the kiloton range. Even reactor-grade plutonium is weapon-usable material—this was proved in a 1962 test in the United States.[7] The theoretical critical mass with reactor-grade plutonium is merely 7 kg.[8] Thus, the amount of reactor-grade plutonium needed for a kiloton-range bomb is merely 40 percent more than that needed for a weapon-grade plutonium bomb. By the year

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[7]Letter from Wilbur A. Strauser, Chief, Weapons Branch, Division of Classification, Energy Research and Development Administration, to Richard Bowen, Division of International Security Affairs, August 4, 1977.

[8]We used the data on isotopic composition of reactor-grade plutonium given by Robert Selden. "Reactor Plutonium and Nuclear Explosives," Lawrence Livermore Laboratory, n.d., and interpolated the data in the critical mass table provided by Theodore Taylor, "Nuclear Safeguards," *Annual Review of Nuclear Science*, Vol. 25, 1975, p. 413.

2003, there will be enough surplus plutonium from dismantled nuclear weapons to make 40,000 primitive bombs (Figure S.1). Reactor-grade plutonium separated from civilian spent fuel will be sufficient to make 47,000 bombs. By 2010, although the amount of plutonium available from dismantled nuclear weapons is expected to stay about the same, plutonium separated from spent fuel will be sufficient to make 71,000 bombs.

Before discussing the U.S. policy toward fissile materials from FSR dismantled nuclear weapons, we discuss timely warning in nuclear safeguards and elaborate on a desirable path for the world's civilian nuclear development.

TIMELY WARNING IN NUCLEAR SAFEGUARDS

Effective safeguards do not merely detect the diversion of nuclear materials or facilities for making bombs. If the diverted materials or facilities are in such form that nuclear weapons can be made in days

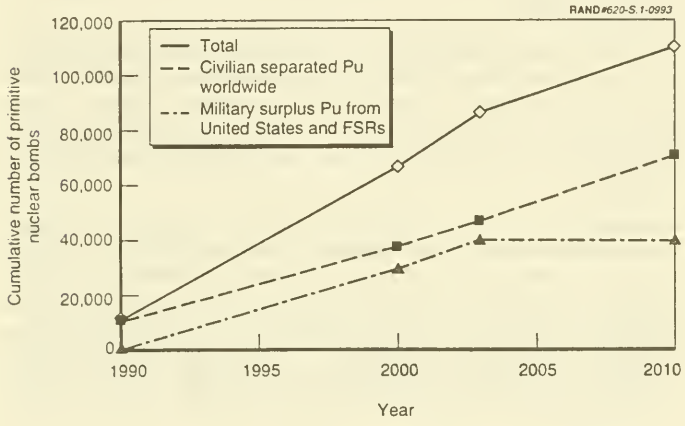

Figure S.1—Number of Primitive Nuclear Bombs That Can Be Made from Separated Plutonium

or weeks, the United States and other countries would not have enough time to amass sufficient political and other pressures to prevent the completion of the bomb-making process. The warning time from detection to bomb production needs to be at least about a year. Notwithstanding the procedures and devices currently used by IAEA to safeguard sensitive facilities, it is an illusion that they can be effectively safeguarded according to any sound view of timely warning. These sensitive materials and facilities are just too difficult for any safeguard system to handle. The newer commercial enrichment plants in countries such as Japan, Germany, and the Netherlands are based on gas centrifuge, and converting them to the manufacture of weapon-usable uranium would take only days. The international community should also worry about dedicated sensitive military facilities such as the enrichment plant in Pakistan. As for plutonium, separated plutonium held in inventory could be diverted and reworked to make it weapon-ready in only days or weeks.

RECOMMENDED PATH FOR FUTURE CIVILIAN NUCLEAR DEVELOPMENT

There is no need to proliferate the enrichment facilities worldwide to meet countries' nuclear energy needs. Rather, enrichment facilities should be confined to current nuclear weapon states. With enrichment services available from several sources of different ideologies, a country need not be concerned about its supply being cut off.

Currently, civilian use of plutonium is not yet widespread. In fact, civilian nuclear power based solely on uranium is preferable to using plutonium. Plutonium use creates no economic benefits but much proliferation risk. Both thermal recycle[9] and plutonium-fueled fast reactors are not and will not be economically competitive with the current nuclear plants operating in the once-through mode. We estimate that thermal recycle will be uneconomical until the price of uranium-bearing yellowcake rises to \$100/lb U_3O_8. We project that

[9]Thermal recycle is defined as the operations of reprocessing plutonium and uranium from spent fuel and using plutonium-bearing mixed-oxide (MOX) fuel in thermal, the current type, nuclear power plants.

that price will not be reached until 50 years from now. We further project that fast reactors are not expected to be profitable until the yellowcake price reaches \$220/lb U_3O_8 100 years from now. Even in an unlikely scenario extremely favorable to plutonium use, thermal recycle and fast reactors will not be profitable until the yellowcake price reaches \$50/lb U_3O_8 and \$140/lb U_3O_8, respectively. Adjusting for the situation in this scenario in which higher nuclear capacity growth leads to a faster rise in uranium price, we project that it will still take 30 years and 50 years, respectively, for thermal recycle and fast reactors to be economical. Both thermal recycle and plutonium-based fast reactors were planned worldwide during the early days of nuclear power, when projected nuclear capacity was routinely overestimated and uranium resources underestimated.

Countries now have enough time to explore a nuclear future that is more proliferation-resistant. In keeping with this goal, we recommend a four-element civilian nuclear program.

First, the United States, Canada, Sweden, and others who have indefinitely postponed plutonium use should urge other countries to terminate or slow their plutonium activities. One way to discourage plutonium activities is to not renew reprocessing contracts with the United Kingdom and France or to convert current or future reprocessing contracts into contracts to store or dispose of spent fuel.

If the United States cannot convince the United Kingdom and France to scale down their plutonium activities outright, a second-best option would be to encourage them to use weapon-grade plutonium from FSRs instead of reprocessing additional plutonium from spent fuel. Leaving plutonium in spent fuel is a practical and inexpensive way for all countries to save plutonium for unexpected future use. Countries should store spent fuel instead of separated plutonium.

This element will affect industrialized, nonnuclear weapon states such as Japan the most. Japan should not maintain all of its plutonium activities. After all, in the July 1993 Group-7 summit, Japan refused to endorse an indefinite extension of the NPT and wants to retain the option of developing nuclear weapons.[10] Although the

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[10]Jim Mann and Leslie Helm, "Japan Shifts Its Stand on Ruling Out A-Bomb," *Los Angeles Times*, July 9, 1993, pp. A1 and A9.

government has reversed this position,[11] it or subsequent administrations can change its mind again. Japan should at least be urged to scale back its plan to use plutonium in 12 commercial reactors by the year 2005 to only two reactors and to cancel its planned construction of two plutonium-fueled demonstrators—the Demonstrator Advanced Thermal Reactor and the Demonstrator Fast Breeder Reactor. Neither will they need to construct additional supporting facilities for reprocessing and fabricating plutonium. Reducing to two reactors for thermal recycle plus the two breeder demonstrators—Joyo and Monju—should satisfy Japan's insistence on developing plutonium technology. (It may be willing to forgo development completely if the fourth element of our program, to be discussed below, is adopted.)

The second element in our program aims to extend the period during which countries can rely on current nuclear power plants, which operate in the once-through mode and are proliferation-resistant. Countries could pursue programs to improve uranium efficiency in current reactors, by high burnup, for example. The United States should initiate a joint effort with other countries to assess better the extraction costs and amounts of uranium resources, both the conventional and unconventional types, such as those from marine phosphates and seawater. A systematic evaluation will likely further enhance confidence that the earth has plenty of uranium to support the current types of once-through reactors well into the next century and beyond.

The third element in our proposed program is to shift the current emphasis on advanced reactor development programs worldwide to proliferation-resistant reactors. Reactor concepts have already been proposed in which uranium is consumed at a much lower rate—less than one-fifteenth of the uranium used in current nuclear power plants. In other words, if there is enough uranium to support any given level of nuclear capacity for 30 years, such new reactors, once fully deployed, could support the same capacity for the next 450 years, which is long by any planner's standard. Even if these new concepts proved not to work, the world would still have enough time

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[11] Jacob Schlesinger, "Japan Supports Open Extension of Nuclear Treaty," *Wall Street Journal*, September 28, 1993.

to return to the traditional plutonium-bearing fuel cycles and reactors—thermal recycle and breeders.

Our fourth element is to establish an international arrangement for the contingency that plutonium use turns out necessary after all. Although we prefer to see countries eliminate all use of plutonium, some countries such as the United Kingdom and France have made a substantial financial commitment in plutonium and might not be willing to mothball their existing facilities or stop those under construction. If they continue plutonium activities, the related sensitive facilities, as well as those for uranium enrichment, should be confined within existing declared nuclear weapon states. Any exceptions should be eliminated when this fourth element is implemented. During the interim, exceptions should be made only rarely, where mothballing or moving existing plants to a nuclear weapon state or stopping projects well under construction will create a severe financial hardship. Some such plants in Japan and the Netherlands may qualify for exemption. No exception should be made for plants or upgrades still in the planning stage and in early stages of construction.

To placate nonnuclear weapon states, those nuclear weapon states participating in sensitive civilian activities should agree to share fully any benefits through energy credits and rebates. Such an agreement should assure nonnuclear weapon states that they can terminate their own programs on sensitive civilian activities without compromising much on their future security of supply and commercial competitiveness. Furthermore, nonnuclear weapon states should be free to conduct research, development, and production of nonsensitive components of sensitive systems. Such components include steam generators, heat exchangers, valves, temperature and other sensors, and gauges.

The Administration's aim to cut off the production of plutonium and HEU for nuclear weapons in all countries is worthy enough. We recommend that it be extended to include the cutoff of plutonium separation from power and research reactors. Moreover, the United States should propose that sensitive enrichment plants, such as the popular civilian centrifuge enrichment plants, be confined to the five declared nuclear weapon states. Below, we discuss policies toward FSR military fissile materials that are consistent with the goal of a

desirable civilian nuclear future—one that is proliferation-resistant yet requires little economic sacrifice, if not actually bringing financial gains.

RECOMMENDED U.S. POLICY TOWARD HIGHLY ENRICHED URANIUM FROM FSRs

Blending HEU with natural or depleted uranium to produce low-enriched uranium (LEU) as soon as HEU comes out of the dismantled nuclear weapons essentially eliminates the weapon-usable form of uranium. Moreover, the HEU is highly valuable, because the value of the resulting LEU for reactor use is much higher than the blending cost. The 640 tonnes of HEU becoming surplus over the next 10 years in FSRs is worth $6 billion, and the 340 tonnes of surplus HEU in the United States is worth $3 billion.[12] The resulting LEU will meet about half the annual requirements for natural uranium and enrichment worldwide over the next decade. We recommend that the United States not release its military uranium, to soften any market disruption. Then the FSR military uranium alone will account for a smaller, but still sizable, 30 percent of the market. We further recommend that countries use blended-down uranium in their nuclear reactors and that they stockpile natural and low-enriched uranium as a means to absorb the excess supply and, as some countries are still worried about unexpected uranium shortage, to enhance security of supply. We also recommend that the United States encourage other countries to make purchases directly from FSRs or to repurchase what the United States has already bought. Such transactions are practical ways for countries to help FSRs. The United States should not have to shoulder all the financial burden of uranium purchases, especially when FSRs are likely to have twice as much HEU as many had thought only recently. Finally, the United States should favor conducting the blending operations in FSRs to create jobs for their defense and other workers.

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[12]We assumed that the materials will become available in equal annual amounts throughout the next 10 years and that the annual discount rate is 10 percent. We estimated the undiscounted figures to be $9 billion and $4.5 billion, respectively. It has also been reported that the HEU in FSRs might be twice as much. Thus, the value would be doubled.

RECOMMENDED U.S. POLICY TOWARD WEAPON-GRADE PLUTONIUM FROM FSRs

We have examined five options for dealing with weapon-grade plutonium. The first is to use the plutonium as fuel in existing fast reactor demonstrators without reprocessing. The second option is to use it in light water reactors fueled with one-third or partial plutonium-bearing MOX without reprocessing. We call this option LWR (PM, w/o R). The third option is to use the plutonium in light water reactors fully fueled with MOX without reprocessing—LWR (FM, w/o R). The fourth is to store plutonium for, say, 20 years. The last option is to dispose of the plutonium by mixing it with waste or spent fuel when the waste or spent fuel is being prepared for final disposal. None of these options produces any commercial value for weapon-grade plutonium.

In the first three options, even if the weapon-grade plutonium is free, the extra cost in handling the highly radioactive and toxic plutonium outweighs the savings from using less uranium and enrichment. Using weapon-grade plutonium as fuel in fast reactors actually has a net cost of $18,000/kg; in LWR (PM), $7,600/kg; and in LWR (FM), $5,600/kg. The storage cost for 20 years is $3,800/kg. One way to dispose of plutonium is to mix it with waste or spent fuel being prepared for final disposal. The marginal cost for this approach is $1,000/kg. The U.S. repository, however, will not be ready for operation until 2010, and neither FSRs nor other countries have such repositories. Thus, to adopt the disposal option, interim plutonium storage cost must also be factored in. Even in the three options of using plutonium as fuel, plutonium storage cost might have to be paid for up to 10 years, because the reactors may not be ready for plutonium-bearing fuel immediately. Taking the storage cost into account, we find that the cost differences among the fueling options in LWRs and the store-now-and-dispose-later option are all between $4,000/kg and $10,000/kg. Although the difference in total cost for handling the FSR 110 tonnes of weapon-grade plutonium might amount to $660 million, that is not extremely large by national standards. The key policy factor should still be the proliferation risk in each option, not economics. On the other hand, since blending down HEU resolves the proliferation risk, economics becomes the key consideration for the HEU policy.

Even at $10,000/kg, the cost to eliminate the FSR 110 tonnes of weapon-grade plutonium would be $1.1 billion. This is not high relative to the potential risk of leaving it in the hands of FSRs. We recommend that, instead of charging FSRs $1.1 billion to eliminate their weapon-grade plutonium, the United States, alone or with some help from the United Kingdom and France, should buy it for, say, the same price. With the purchase, the primary objective of taking weapon-grade plutonium out of the unstable FSRs is accomplished. Whether the plutonium is stored or burned depends on what bargain we can strike with FSRs and our allies. If it is stored, the United States is the preferred location, but storage in the United Kingdom or France would be acceptable too. If it is burned, that could be accomplished in the already available plutonium-bearing fabrication facilities and nuclear power plants in the United Kingdom and France. But the United States should engage in a negotiation with them to reduce the amount of plutonium to be recovered from spent fuel. This way, weapon-grade plutonium could be eliminated while discouraging reprocessing. Thus, the United States should seek money from the United Kingdom and France to purchase FSR weapon-grade plutonium and/or should ask them to burn this plutonium without charging the United States or FSRs a fee.

Even after the best efforts of the United States and others, the FSRs might still refuse to let their weapon-grade plutonium leave the country, even though it has no economic value and will cost the FSRs money to manage. Then, a second option would be to dispose of it in the FSRs. Unfortunately, like other countries, the FSRs might not have a suitable repository for the next 10 to 20 years. Using weapon-grade plutonium as fuel in the FSRs also faces problems. For at least the next several years, FSRs will lack the needed fabrication facilities and appropriate nuclear reactors to eliminate the weapon-grade plutonium released from their dismantled weapons.

Nonnuclear weapon states such as Japan and Germany could help the FSRs build MOX fabrication plants or modify nuclear reactors to use plutonium-bearing fuel in the FSRs, but Japan and Germany (and other nonnuclear weapon states) should not conduct these activities in their own countries. Otherwise, other nonnuclear weapon states, such as North Korea and Iran, might be unwilling to forgo sensitive civilian activities or plans.

Whatever the nuclear weapon states do to dispose of their weapon-usable materials or to restrict their production, their activities should not encourage nonnuclear weapon states to start or continue sensitive civilian or military nuclear programs. For this reason, sensitive enrichment facilities should not be placed in nonnuclear weapon states and the world should not plunge into a plutonium economy. The economic benefits of plutonium use are distant and uncertain. The nuclear proliferation risks, however, are very real. Therefore, indefinite postponement of plutonium activities will not only save money but also make the world safer.

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Management and Disposition of Excess Weapons Plutonium

Committee on International Security and Arms Control

National Academy of Sciences

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Executive Summary

Under the first and second Strategic Arms Reduction Treaties (START I and II) and unilateral pledges made by Presidents Bush, Gorbachev, and Yeltsin, many thousands of U.S. and Russian nuclear weapons are slated to be retired within the next decade. As a result, 50 or more metric tons of plutonium on each side are expected to become surplus to military needs, along with hundreds of tons of highly enriched uranium (HEU). These two materials are the essential ingredients of nuclear weapons, and limits on access to them are the primary technical barrier to acquisition of nuclear weapons capability in the world today. Several kilograms of plutonium, or several times that amount of HEU, are sufficient to make a nuclear weapon.

The existence of this surplus material constitutes a clear and present danger to national and international security. None of the options yet identified for managing this material can eliminate this danger; all they can do is to reduce the risks. Moreover, none of the options for long-term disposition of excess weapons plutonium can be expected to substantially reduce the inventories of excess plutonium from nuclear weapons for at least a decade.

PRINCIPAL RECOMMENDATIONS

Our study of this problem leads us to the following four principal recommendations:

1. *A New Weapons and Fissile Materials Regime.* We recommend that the United States work to reach agreement with Russia on a new, reciprocal regime that would include:

(a) declarations of stockpiles of nuclear weapons and all fissile materials;
(b) cooperative measures to clarify and confirm those declarations;
(c) an agreed halt to the production of fissile materials for weapons; and
(d) agreed, monitored net reductions from these stockpiles.

Monitoring of warhead dismantlement and commitment of excess fissile materials to non-weapons use or disposal, initially under bilateral and later under international safeguards, would be integral parts of this regime, as would some form of monitoring of whatever warhead assembly continues.

2. *Safeguarded Storage.* We recommend that the United States and Russia pursue a reciprocal regime of secure, internationally monitored storage of fissile material, with the aim of ensuring that the inventory in storage can be withdrawn only for non-weapons purposes.

3. *Long-Term Plutonium Disposition.* We recommend that the United States and Russia pursue long-term plutonium disposition options that:

(a) minimize the time during which the plutonium is stored in forms readily usable for nuclear weapons;
(b) preserve material safeguards and security during the disposition pro-cess, seeking to maintain the same high standards of security and accounting applied to stored nuclear weapons;
(c) result in a form from which the plutonium would be as difficult to recover for weapons use as the larger and growing quantity of plutonium in commercial spent fuel; and
(d) meet high standards of protection for public and worker health and for the environment.

The two most promising alternatives for achieving these aims are:

- fabrication and use as fuel, without reprocessing, in existing or modified nuclear reactors; or
- vitrification in combination with high-level radioactive waste.

A third option, burial of the excess plutonium in deep boreholes, has until now been less thoroughly studied than have the first two options, but could turn out to be comparably attractive.

4. *All Fissile Material.* We recommend that the United States pursue new international arrangements to improve safeguards and physical security over all forms of plutonium and HEU worldwide. In particular, new cooperative efforts to improve security and accounting for all fissile materials in the former Soviet Union should be an urgent priority.

Because plutonium in spent fuel or glass logs incorporating high-level wastes still entails a risk of weapons use, and because the barrier to such use diminishes with time as the radioactivity decays, consideration of further steps

to reduce the long-term proliferation risks of such materials is required, regardless of what option is chosen for disposition of weapons plutonium. This global effort should include continued consideration of more proliferation-resistant nuclear fuel cycles, including concepts that might offer a long-term option for nearly complete elimination of the world's plutonium stocks.

On September 27, 1993, the Clinton administration announced a nonproliferation initiative that included some first steps in the directions recommended above, among them a proposal for a global convention banning production of fissile materials for weapons; a voluntary offer to put U.S. excess fissile materials under International Atomic Energy Agency (IAEA) safeguards; and a recognition that plutonium disposition is an important nonproliferation problem requiring renewed interagency, and ultimately international, attention. This is a much needed and timely start; more, however, remains to be done.

CRITERIA AND CONTEXT

The steps we recommend are designed to meet three key security objectives:

1. to minimize the risk that either weapons or fissile materials could be obtained by unauthorized parties;
2. to minimize the risk that weapons or fissile materials could be reintroduced into the arsenals from which they came, thereby halting or reversing the arms reduction process; and
3. to strengthen the national and international arms control mechanisms and incentives designed to ensure continued arms reductions and prevent the spread of nuclear weapons.

Other key criteria include protecting worker and public health and the environment; being acceptable to the public and the institutions whose approval is needed; and, to the extent consistent with other criteria, minimizing costs and delays.

We note that the expenditures implied by all our recommendations combined would total at most several billion dollars, spread over a period of a decade or decades. Since the primary objective is the reduction of major security risks, these expenditures should be considered in the context of the far larger sums being spent every year to provide national and international security. Thus, although the costs of alternate approaches are important and are discussed in the report, cost is not the primary criterion in choosing among competing options. Moreover, exploiting the energy value of plutonium should not be a central criterion for decision making, both because the cost of fabricating

and safeguarding plutonium fuels makes them currently uncompetitive with cheap and widely available low-enriched uranium fuels, and because whatever economic value this plutonium might represent now or in the future is small by comparison to the security stakes.

World Stocks of Fissile Materials

The problem of management and disposition of excess weapons plutonium must be considered in the context of the large world stocks of fissile materials. While all but a small fraction of the world's HEU is in military use, civilian stocks of plutonium are several times larger than military stocks and are growing much faster, by some 60 to 70 tons each year. Most of these civilian stocks, however, are in the form of radioactive spent fuel from the world's power reactors, from which the plutonium is difficult to extract. The difficulty of extracting this plutonium declines substantially as the radioactivity of the fuel decays over the decades after it leaves the reactor. Roughly 130 tons of plutonium have been separated from spent fuel for reuse as reactor fuel, of which some 80 to 90 tons remains in storage in separated form.

Plutonium customarily used in nuclear weapons (weapons-grade plutonium) and plutonium separated from spent reactor fuel (reactor-grade plutonium) have different isotopic compositions. Plutonium of virtually any isotopic composition, however, can be used to make nuclear weapons. Using reactor-grade rather than weapons-grade plutonium would present some complications. But even with relatively simple designs such as that used in the Nagasaki weapon—which are within the capabilities of many nations and possibly some subnational groups—nuclear explosives could be constructed that would be assured of having yields of at least 1 or 2 kilotons. Using more sophisticated designs, reactor-grade plutonium could be used for weapons having considerably higher minimum yields. Thus, the difference in proliferation risk posed by separated weapons-grade plutonium and separated reactor-grade plutonium is small in comparison to the difference between separated plutonium of any grade and unseparated material in spent fuel.

While plutonium and HEU can both be used to make nuclear weapons, there are two important differences between them. The first is that HEU can be diluted with other, more abundant, naturally occurring isotopes of uranium to make low-enriched uranium (LEU), which cannot sustain the fast-neutron chain reaction needed for a nuclear explosion. LEU is the fuel for most of the world's nuclear power reactors. In contrast, plutonium cannot be diluted with other isotopes of plutonium to make it unusable for weapons. "Re-enriching" LEU to the enrichment needed for weapons requires complex enrichment technology to which most potential proliferators do not have access, while separating plutonium from other elements with which it might be mixed in fresh reactor fuel requires only straightforward chemical processing. Thus, the

management of plutonium in any form requires greater security than does the management of LEU.

Second, as noted earlier, in the current nuclear fuel market, the use of plutonium fuels is generally more expensive than the use of widely available LEU fuels—even if the plutonium itself is "free"—because of the high fabrication costs resulting from plutonium's radiological toxicity and from the security precautions required when handling it. As a result, while most of the world's roughly 400 nuclear reactors could in principle burn plutonium in fuel containing a mixture of uranium and plutonium (mixed-oxide or MOX fuel), few—and none in the United States—are currently licensed to do so.

The United States has agreed to buy 500 tons of surplus Russian HEU, blended to LEU, for $11.9 billion over the next 20 years, provided certain conditions are met. The United States will later resell the material to fulfill the demand for nuclear fuel on the domestic and world markets. While the purchase of Russian plutonium could, similarly, be justified on security grounds, both the security aspects and the economics of using plutonium as reactor fuel would be less attractive than in the case of LEU.

Because of the more difficult technical and policy issues involved, this report focuses primarily on the disposition of plutonium rather than HEU.

The International Environment

The management and disposition of plutonium from dismantled nuclear weapons will take place within a complex international context that includes the arms reduction and nonproliferation regimes of which this problem is an element, the continuing crisis in the former Soviet Union, worldwide plans for civilian nuclear energy (particularly the use of separated plutonium), and existing approaches to safeguards and security for nuclear materials.

Recent *nuclear arms reduction* agreements and pledges, along with national decisions concerning what stocks of plutonium are to be declared "excess," will largely set the parameters of how much plutonium will require disposition and when it will become available. The reductions agreements entail a complex and uneven schedule of reductions in deployed launchers between now and 2003. As yet, no agreement exists to govern the dismantlement of the surplus nuclear weapons, or the modes of storage and eventual disposition of the fissile materials, although discussions of some aspects of the problem are under way. Mutually agreed, monitored provisions for the disposition of fissile materials could help enhance political support for implementation of START II and for agreement on deeper reductions.

The current *crisis in the former Soviet Union* creates a variety of risks with respect to the management and disposition of nuclear weapons and fissile materials. We categorize these as dangers of:

- "breakup," meaning the emergence of multiple nuclear-armed states where previously there was only one;
- "breakdown," meaning erosion of government control over nuclear weapons and materials within a particular state; and
- "breakout," meaning repudiation of arms reduction agreements and pledges, and reconstruction of a larger nuclear arsenal.

Breakup is the most immediate threat, mainly because of uncertainty over whether Ukraine will carry out its denuclearization pledges. Security concerns may well be the driving factors in Ukraine's ultimate decision, but that decision could be affected by measures that ensure that weapons and fissile materials transferred to Russia will not be reused for military purposes, and that provide compensation for these materials.

Breakdown of the elaborate system of control of nuclear weapons and fissile materials in the former Soviet Union remains a possibility, despite Russian efforts to maintain the former Soviet systems for this purpose. The thefts of conventional weapons and nuclear materials other than plutonium and HEU that have already occurred are disturbing. Enhanced assistance in improving security and accounting for fissile materials in the former Soviet Union is a potentially high-leverage area deserving urgent attention. The broad regime of accounting we recommend could provide an important basis for additional steps to improve security of these materials.

Breakout seems unlikely in the near term. The significant nuclear arsenals that each side will retain under START II will further reduce any motivation that a future Russian government might have for taking such a step. Ratification and implementation of START I and START II are not yet assured, however. The steps that we outline would reduce the potential for breakout, and provide a foundation for deeper reductions and for the inclusion of additional parties in the future.

The foundation of the *nuclear nonproliferation regime* is the Non-Proliferation Treaty (NPT), which is up for extension in 1995. Agreements for secure, safeguarded management and disposition of fissile materials from surplus nuclear weapons could help make clear that the nuclear powers are fulfilling their disarmament obligations under Article VI of the NPT. Moreover, acceptance by the major nuclear powers of safeguards and constraints on substantial portions of their nuclear programs would help to reduce the inherently discriminatory nature of the nonproliferation regime. These steps, while probably not dissuading all nations that might be attempting to acquire nuclear weapons, would help build global political support for indefinite extension of the NPT and strengthening the regime, which are major U.S. policy goals.

International efforts to reduce the proliferation risks posed by the existence of civilian plutonium and enriched uranium rest on *safeguards*, which are national and international measures designed to detect diversion of ma-

terials and enable a timely response, and *security*, which consists of (currently national) measures designed to prevent theft of materials through the use of barriers, guards, and the like. Standards for both vary widely. Those applied to civilian materials, even separated plutonium and HEU, are less stringent than those applied to nuclear weapons and fissile material in military stocks. Varying and lower standards may be justified in the case of spent fuel for the first decades outside the reactor, when its high radioactivity makes it difficult to steal or divert, but they are not justified in the case of separated civilian plutonium or HEU. New steps toward improved and consistent international standards should be pursued.

Choices regarding the fissile materials from dismantled weapons may also affect and be affected by *civilian nuclear power programs*, a topic that depends on economic, political, and technical factors outside the scope of this study. In some countries, nuclear power programs already include the use of plutonium in the fuel loaded into reactors. But the amount of weapons plutonium likely to be surplus is small on the scale of global nuclear power use—the equivalent of only a few months of fuel for existing reactors—and it is not essential to the future of civilian nuclear power. There is thus no reason that disposition of this weapons plutonium should drive decisions on the broader questions surrounding the future of nuclear power.

The production of tritium was not part of our charge, and we have not examined alternatives for this purpose in detail. We believe, however, that there is no essential reason why plutonium disposition and tritium production need be linked, and there appear to be good arguments why they should not be. Technically, the scale of the plutonium disposition task is very much larger than any tritium production requirement. From a policy perspective, producing weapons materials in the same facility that was destroying other weapons materials would raise political and safeguards issues.

THE PROPOSED WEAPONS AND FISSILE MATERIALS REGIME

We recommend a broad transparency regime for nuclear weapons and fissile materials, as outlined above. This regime could be approached step-by-step, with each step adding to security while posing little risk. The regime we envision would include a variety of measures applying to each phase of the life cycle of military fissile materials: production and separation of the materials; fabrication of fissile material weapons components; assembly, deployment, retirement, and disassembly of nuclear weapons; and storage and eventual disposition of fissile materials. These measures should be mutually reinforcing, to build confidence that the information exchanged is accurate and that the goals of the regime are being met.

There is likely to be some resistance to a regime of full accounting and monitoring of total weapons and fissile material stocks and facilities, but such a regime meets objectives shared by the United States and Russia (and, for that matter, by many other countries). Moreover, extensive data exchanges and verification measures have already been agreed for deployed strategic nuclear forces and other military systems.

Declarations of total stocks of weapons and fissile materials, with their locations, coupled with exchanges of operating records and inspections of material production sites, would reduce the large uncertainty in present estimates of these stocks. Fissile material production facilities and their operating records can be examined to confirm consistency with reported production figures, and stocks of fissile materials and weapons at declared sites can be confirmed through routine and occasional challenge inspections. The commitment of the Russian and U.S. governments to such declarations and the progressive opening of Russian society should make it less likely that a stockpile or production facility of any significant size could be hidden.

Dismantlement should also be monitored. The United States is dismantling its nuclear weapons at a rate of somewhat less than 2,000 per year, with a goal of increasing that rate to 2,000—the maximum rate permitted by available facilities; personnel; and environment, safety, and health (ES&H) considerations. The plutonium components ("pits") are being placed intact into containers and put in intermediate storage at the Pantex disassembly site near Amarillo, Texas. The HEU components are being shipped to the Y-12 plant at Oak Ridge, Tennessee, for storage and eventual use as naval or civilian reactor fuel. Russian spokesmen have declared that Russia is dismantling nuclear weapons at four sites, at a rate comparable to the U.S. rate, and is storing the materials at several existing sites.

Neither the United States nor Russia plans to monitor the other's dismantlement, although limited Ukrainian monitoring is reported to be in place in Russia. Means exist or could be developed to monitor dismantlement without undue interference or costs, while protecting sensitive information. As with other parts of the regime, some declassification would be necessary to permit effective monitoring. The basic approach would be a variant of the perimeter-portal monitoring system now in place to verify that missiles banned by the Intermediate-Range Nuclear Forces treaty are not being produced; warheads entering and leaving the facility would be counted, and amounts of fissile material measured. Such monitoring could be applied without undue interference with necessary maintenance and modification of the remaining military stockpile.

A *cutoff of production of weapons materials* would require monitoring of enrichment and reprocessing facilities. Still greater confidence could be achieved if all fuel cycle facilities were monitored. These tasks could be carried out by bilateral or international monitors (or both), using means that have

met international acceptance in nonproliferation verification. Continued production of HEU for naval reactors and tritium for nuclear stockpile maintenance would introduce some complications, but these could readily be addressed through careful design of the agreement and the monitoring system.

The United States is no longer producing plutonium or HEU for weapons. Russia has also ceased production of HEU for weapons, but is still operating plutonium production reactors and separating the resulting weapons-grade plutonium. The Russian government asserts that these reactors provide necessary heat and power to surrounding areas, and that the fuel must be reprocessed for safety reasons. The United States has begun discussions with Russia about assistance in converting these reactors so that separated weapons plutonium is not generated, or in providing alternate power sources, but these discussions remain embryonic.

Internationalizing the Regime

The security goals outlined above would be best served if the standards set by this regime for managing U.S. and Russian excess weapons and fissile materials were extended worldwide. In particular, new agreements should be pursued to:

1. create consistent, stringent international standards of accounting and security for fissile materials;
2. end all production of fissile materials for nuclear weapons, worldwide;
3. create an international system of declarations and inspections covering declared nuclear weapons arsenals, including reserves, and fissile material stocks (complementing the declarations and inspections already required of non-nuclear-weapon-state parties to the Non-Proliferation Treaty); and
4. create an international safeguarded storage regime under which all civilian fissile materials not in immediate use would be placed in agreed safeguarded storage sites, with agreed levels of physical security.

The IAEA secretariat and organizations in several countries are now working on concepts for such universal reporting and safeguarding of civilian fissile materials. These steps, and others that we recommend, would require increased resources for the IAEA, as well as organizational improvements. In some cases resources could be provided specifically for a new task. But the agency also urgently needs more resources overall.

INTERMEDIATE STORAGE

Present and Planned Arrangements

It will be necessary to provide secure intermediate storage of surplus weapons plutonium for decades, since long-term disposition will take years to start and possibly decades to complete. In both the United States and Russia, fissile materials from dismantled weapons are currently stored in the form of weapons components, some at the dismantlement site and some elsewhere. Neither country has yet decided how much will be held in reserve. No monitoring or transparency measures relating to storage of these fissile materials are yet in place, although the Clinton administration has announced that U.S. excess fissile materials will be placed under international safeguards, and Russia has expressed willingness to do the same. Russia and the United States also have tens of tons of weapons-grade plutonium not incorporated in weapons that are stored in various forms at several sites in their weapons complexes.

In the United States, plutonium from weapons is being stored temporarily in simple "igloos" at Pantex, the dismantlement site. This arrangement provides high security and generally adequate standards of protection for environment, safety, and health. Given the stability of both the pits and the facilities at the site, there is no technical or economic reason why this arrangement could not be continued for a considerable time, but the public and the authorities in the area surrounding the site have been assured that interim storage there will not be extended beyond a decade. To meet that pledge, and to provide improved storage for plutonium in other forms now stored at several widely dispersed sites, the Department of Energy proposes to invest in a new, consolidated facility for long-term storage at a site to be selected. No full analysis of the advantages and disadvantages of this approach compared to upgrading existing storage facilities has been completed. We therefore do not offer a recommendation, though we recognize the safeguards and security advantages that a new consolidated facility might offer.

Less is known about Russian storage arrangements. Russia has requested, and the United States has agreed to provide, assistance in constructing a storage facility for excess fissile materials from weapons. We support construction of a facility designed to consolidate all these excess weapons materials, as this would facilitate security and international monitoring.

There is considerable debate concerning the optimum physical form in which to store plutonium. We recommend that, for the time being, plutonium continue to be stored in the form of intact weapons components. Decades of experience have demonstrated that pits are relatively safe and stable, and storage in this form would postpone the costs and ES&H issues of conversion to other forms. Although the design of pits is sensitive, international monitors could externally assay the amount of plutonium in a canister containing a pit

without, in most cases, revealing sensitive design information. Intact pits can more easily be reused for weapons by the state that produced them than plutonium in other forms, but they probably do not pose substantially greater proliferation risks than storage as deformed pits or metal ingots. Deformation of pits and perhaps other steps to reduce the rearmament risk should be given serious consideration, and should be undertaken if they can be accomplished at relatively low cost and ES&H risk.

One cannot be confident, however, that plutonium in pits can be stored without degradation for more than a few decades. When a definite decision regarding long-term disposition has been made, the pits should be converted into the forms required for that disposition option, under agreed safeguards and security.

A New Storage Regime

The following measures constitute a regime for intermediate storage of surplus fissile materials that serves the objectives noted earlier with minimum disruption to the process of dismantlement and storage:

1. *Commitment to Non-Weapons Use.* The United States and Russia should commit a large fraction of the fissile materials from dismantled weapons to non-weapons use. They should agree on the specific amounts.
2. *Safeguarded Storage and Disposition.* The preceding commitment should be verified by monitoring of the present and future sites where fissile materials are stored, and continued monitoring of the material after it leaves these sites for long-term disposition.
3. *IAEA Involvement.* Although such monitoring might begin bilaterally, the IAEA should be brought into the process expeditiously, in an expansion and strengthening of its nonproliferation role. The IAEA would monitor the amount of material in the storage site and safeguard any material removed from the site to ensure its use for peaceful purposes. Such safeguards would be an extension of the existing safeguards system. Bilateral monitoring would probably continue as well.

Financial or other incentives could be provided to Russia for putting the material into storage. Management, control, or outright ownership of the stores and the material in them might be transferred to other parties, such as an international consortium formed for that purpose. The material might even be physically relocated to some other country, possibly in return for cash, as in the case of the HEU deal. Such incentives would not obviate the need for, and are secondary to, prompt agreement on a storage regime along the lines recommended here.

LONG-TERM DISPOSITION

Categories, Criteria, and Standards

The technical options for long-term disposition of excess weapons plutonium can be divided into three categories:

- *indefinite storage*, in which the storage arrangements outlined in the previous section would be extended indefinitely;
- *minimized accessibility*, in which physical, chemical, or radiological barriers would be created to reduce the plutonium's accessibility for use in weapons (either by potential proliferators or by the state from whose weapons it came), for example, by irradiating the plutonium in reactors or mixing it with high-level wastes; and
- *elimination*, in which the plutonium would be made essentially completely inaccessible, for example, by burning it in reactors so completely that only a few grams would remain in a truckload of spent fuel, or by launching it into deep space.

In both the "minimized accessibility" and the "elimination" categories, some of the options *use* the plutonium to generate electricity, while others *dispose* of the plutonium without using its energy content. Both classes of options would involve net economic costs. The electricity generation options would produce revenues, but the costs of using plutonium to produce this electricity would be higher than the costs of generating it using enriched uranium. The current Russian government nonetheless sees weapons plutonium as a valuable asset and therefore strongly prefers options that use the plutonium.

Risks of Storage. Although intermediate storage is an inevitable step preceding all disposition options, it should not be extended longer than necessary. Maintaining this material in a readily weapons-usable form over the long term would send negative political signals for nonproliferation and arms reduction, and the security offered by indefinite storage against the risks of breakout and theft is entirely dependent on the durability of the political arrangements. Indeed, one of the key criteria by which disposition options should be judged is the speed with which they can be accomplished, and thus how rapidly they curtail these risks of storage.

Risks of Handling—The "Stored Weapons Standard." Although options in the "minimized accessibility" and "elimination" classes decrease the long-term accessibility of the material for weapons use, they could increase the short-term risks of theft or diversion because of the required processing and transport steps. In order to ensure that the overall process reduces net security risks, an agreed and stringent standard of security and accounting must be maintained throughout the disposition process, approximating as closely as

capability and the needed approvals and licenses) and be completed within 20 to 40 years thereafter (paced by the number of reactors used, the fraction of the reactor core using plutonium fuel, the percentage of plutonium that this fuel contains, and the amount of time that the fuel remains in the reactor). Examples include:

• *U.S. Light-Water Reactors*. The predominant commercial reactors in the world today are light-water reactors (LWRs). Without major modifications, typical LWRs could burn a fuel consisting of mixed oxides of plutonium and uranium (MOX) in one-third of their reactor cores. Four existing LWRs in the United States (three operational at Palo Verde in Arizona, and one 75 percent complete in Washington State) were designed to use MOX in 100 percent of their reactor cores; a single such reactor, using fuel containing somewhat more plutonium than would be used if energy production alone were the aim, could transform 50 tons of weapons plutonium into spent fuel in 30 years. Alternatively, other operating or partly completed reactors could also be modified to use full MOX cores, or a new full-MOX reactor might be built on a government site, with costs partly offset by later sales of electricity.

Although the United States has no operating MOX fuel fabrication capability, there is an unfinished facility at the Hanford site that could be completed and modified for this purpose; alternatively, a new MOX facility could be built in roughly a decade, at significantly higher cost.

This option is technically demonstrated, as LWRs in several countries are burning MOX fuels today. Environmental, health, and safety risks can be minimized with the application of money and good management, although some of the specifics of how best to do so require further study. Use of MOX fuels, however, would be controversial in the United States, where such fuels are not now used, and gaining licenses and public approval could raise difficulties. The subsidy required to transform 50 tons of plutonium into spent fuel in this way (compared to the cost of producing the same electricity by the means with which it would otherwise be produced) would probably fall in the range from a few hundred million to a few billion dollars, depending on assumptions and on the specific approach chosen.

• *Russian Light-Water Reactors*. Similarly, Russian plutonium could be used as MOX in Russian VVER-1000 reactors (the only existing reactors in Russia likely to be safe enough and long-lived enough for this mission). VVER-1000s that are not yet operational, but that the Russian government plans to complete for electricity production, could be modified to handle full MOX cores, or such modifications could be incorporated in operating reactors during the shutdowns for safety improvements that are now planned. Because of the current political and social upheaval in Russia, safeguards and security risks would be substantial. The current Russian government's preference for storing plutonium until it can be used in the next generation of Russian liquid-

metal fast reactors is not attractive because of the indefinite time before disposition could begin, the security liabilities of prolonged storage, and the high cost of these reactors.

• *CANDUs.* Existing Canadian deuterium-uranium (CANDU) reactors are a technically attractive possibility for this mission, because the reactor design allows them inherently to handle full-MOX cores, with less change from the usual physics of the reactor than in the case of LWRs. The cost of this option is difficult to estimate, as no one has yet attempted to fabricate MOX fuel for CANDU reactors on any significant scale. We do not know whether the opportunity for Canada to participate in an important disarmament process, combined with possible U.S. subsidies for the project, would be attractive enough to cause that country to reverse its long-standing policy against the use of fuels other than natural uranium in its power reactors.

• *Substitution for Civilian Plutonium.* Utilities in Europe and Japan currently plan to use more than 100 tons of reactor-grade plutonium in MOX fuels over the next decade. If excess weapons plutonium from Russia or the United States were substituted for this material—with an associated delay in separation of plutonium from civilian spent fuel, so that additional excess stocks of civilian plutonium did not build up as a result—disposition of 50 or even 100 tons of plutonium could be accomplished relatively rapidly (since the facilities required are already built and licensed, or scheduled to be) and with comparatively small *net additional* safeguards risks (since after the initial transport, all the facilities handling plutonium would have done so in any case). However, the agreements required to implement this option would be complex and probably difficult to reach. Substantial changes in a variety of existing contracts and programs would have to be made, and transport of weapons plutonium to these countries would be controversial.

• *New Reactors for the Plutonium Mission.* Given the high costs and long times required for the construction of new reactors, building such reactors for the mission of transforming weapons plutonium into spent fuel would be justifiable only if problems of licensing and public acceptance made currently operating or partly completed reactors unavailable (and only, of course, if the reactor-MOX option were deemed preferable to the vitrification and deep-borehole approaches). If that proves to be the case, the new reactors should be built on a government-owned site and should be of sufficiently well-proven design so as not to create additional technical and licensing uncertainties. Reactors we have examined of more advanced design do not offer sufficient advantages for this mission to offset the extra costs and delays that their use would entail. In particular, the use of advanced reactors and fuels to achieve high plutonium consumption without reprocessing is not worthwhile, because the consumption fractions that can be achieved—between 50 and 80 percent—

are not sufficient to greatly alter the security risks posed by the material remaining in the spent fuel. Development of advanced reactors and fuel types is of interest for the future of nuclear electricity generation, including the minimization of safety and security risks, but the timing and scope of such development need not and should not be governed by the current weapons plutonium problem.

The Vitrification Option

An alternative means of creating similar radioactive and chemical barriers to weapons use of this material would be to mix it with radioactive high-level waste (HLW) left from the separation of plutonium from weapons and other defense activities. Under current plans, HLW will be mixed with molten glass (vitrified) to produce large glass logs. These logs, like spent reactor fuel, will be stored for an interim period and then placed in a geologic repository. The logs would pose radiological barriers to handling and processing similar to those of spent LWR fuel a few decades old. Incorporating plutonium into these logs appears feasible, although technical questions remain. These technical issues are more substantial than those facing the MOX options, but licensing and public approval appear easier to obtain in the vitrification case, at least in the United States. Vitrification raises fewer security risks in handling than the MOX option, because the process of mixing plutonium with HLW would be easier to safeguard than the more complex process of fabricating MOX. This might be of particular importance in the current Russian context. Russian vitrification efforts have so far focused on a phosphate glass that is less appropriate for this mission than the borosilicate glass used in the United States and elsewhere because it is less durable and offers less protection against the possibility of an unplanned nuclear chain reaction once plutonium is embedded in it. New technologies for comparatively small melters could be transferred to Russia for this purpose. So far, however, the Russian officials responsible for these issues have rejected disposal options such as vitrification.

The Deep-Borehole Option

Disposal in deep boreholes has been examined in several countries as an approach to spent fuel and HLW management, and is still being examined in Sweden. Because of the very great depth of the holes, there are good reasons to believe that the materials emplaced would remain isolated from the environment for periods comparable to or possibly longer than those expected for the geologic repository case, but significant uncertainties must be resolved. Plutonium in such boreholes would be extremely inaccessible to potential proliferators, but would be recoverable by the state in control of the borehole site. The method would be relatively inexpensive to implement, but developing

sufficient confidence to permit licensing could be costly and time-consuming; the United States has expended decades and billions of dollars in preparation for such licensing in the case of geological repositories for spent fuel and HLW.

All three of these options have the potential to be satisfactory next steps beyond interim storage in the disposition of excess weapons plutonium. None of them, however, could be confidently selected until currently open questions, described in Chapter 6 of this report, are answered.

Other Approaches

A variety of other reactors have been proposed for this mission, such as high-temperature gas-cooled reactors, fast-neutron reactors, or various existing research or plutonium production reactors. Existing reactors other than the LWRs and CANDUs described above should be rejected on grounds of the uncertain availability and safety of those reactors with sufficient capacity. The advanced reactors, as noted above, are not competitive for this mission because of the cost and delay of their development, licensing, and construction.

A variety of exotic disposal options have also been proposed, including sub-seabed disposal, detonation in underground nuclear explosions, launching into deep space, and dilution in the ocean, among others. This report rejects all of these on grounds of retrievability, cost, delay, environmental concerns, or conflict with existing policies and international agreements.

Beyond the Spent Fuel Standard

Long-term steps will be needed to reduce the proliferation risks posed by the entire global stock of plutonium, particularly as the radioactivity of spent fuel decays. Options for reducing these risks could include placement of spent fuel in geologic repositories, or pursuit of fission options that would burn existing plutonium stocks nearly completely. A variety of reprocessing-oriented reactor options have been proposed for this mission, ranging from the use of standard LWRs to challenging concepts such as accelerator-based conversion. The costs of these approaches would be in the tens or hundreds of billions of dollars, and the time scales would be many decades or centuries, depending on the choice of options. These technologies can only be realistically considered in the broader context of managing the future of nuclear power to provide energy while minimizing the risk of nuclear proliferation, an important task that is beyond the scope of this committee. To further refine these concepts, research on fission options for near-total elimination of plutonium should continue at the conceptual level.

Although all the plausible disposition options will take many years to implement, it is important to begin now to build consensus on a road map for decision. Such a road map would provide guidelines for the necessary national and international debate to come, focus further efforts on those options most likely to minimize future risks, and provide plausible end points for the process that the near-term steps will set in motion. Research and development should be undertaken immediately to resolve the outstanding uncertainties facing each of the options.

THE INSTITUTIONAL FRAMEWORK

The institutional and political issues involved in managing weapons dismantlement, intermediate storage of fissile materials, and long-term disposition may be more complex and difficult to resolve than the technical ones. Because disposition options will require decades to carry out, it is critical that decisions throughout be made in a way that can muster a sustainable consensus. The entire process must be carefully managed to provide adequate safeguards, security, and transparency; to obtain public and institutional approval, including licenses; and to allow adequate participation in the decision making by all affected parties, including the U.S. and Russian publics and the international community. Adequate information must be made available to give substance to the public's participation.

These issues cover a broad institutional and technical spectrum. Establishing fully developed arrangements for managing these tasks will require an unusually demanding integration of policy under conditions of dispersed authority and intense political sensitivity. In the United States, jurisdiction over fissile material and fabricated weapons is divided between the Department of Energy (DOE) and the Department of Defense (DOD) in different phases of the deployment cycle. Each department has many subordinate divisions involved. Related diplomacy is handled by the State Department and the Arms Control and Disarmament Agency, with input from DOE and DOD. Numerous other agencies perform supporting functions. The relevant installations are authorized and financed by Congress, regulated by independent agencies and commissions, constrained by state laws, and increasingly affected by public opinion in their surrounding communities. Policy debates too often focus on specific options, such as particular reactor types, rather than the comprehensive view required to make choices for this complex problem. The consequences of this fragmentation are illustrated in a related area by the fact that technical assessment of the U.S. high-level waste repository at Yucca Mountain is incomplete after two decades of work and billions of dollars of expenditure, and final licensing is not projected for another two decades. These challenges to comprehensive policymaking are at least as great in Russia, where

they must be surmounted in the midst of continuing political and economic upheaval.

None of the governments involved have previously faced the problem of handling excess plutonium in the quantities now contemplated, and none appear to have developed policies and procedures likely to be adequate to the task. Yet decisions are urgent, since without new approaches even the near-term tasks of dismantlement and storage are not likely to meet all of the required security criteria.

In these areas, the United States bears a special burden of policy leadership. If demanding technical assessments are to be completed, if consensus is to be forged, and if implementation is to be accomplished in reasonable time, major advances in the formulation and integration of policy and in institutional coordination will be needed. The president should establish a more systematic process of interagency coordination to deal with the areas addressed in this report, with sustained top-level leadership. The new interagency examination of plutonium disposition options envisioned in President Clinton's September 27, 1993, nonproliferation initiative is a first step in that direction, but much more remains to be done.

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